Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JUNE 18, 1904. No. 25.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the
McGRAW PUBLISHING CO.
114 LIBERTY STREET, NEW YORK.
TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - 929 Chestnut Street.
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ELECTRICAL WORLD AND ENGINEER.

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The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JUNE 18, 1904.

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ELECTRIFIED PASSENGER TRAFFIC.

The effect of electricity upon the development of street railway traffic has often been referred to, but is again emphasized in the figures brought out by the 1904 edition of "American Street Railway Investments," which is reviewed in our columns this week. This excellent compendium gives among other things a summary of the earnings of 310 street railway companies in the United States; and very interesting data are included. The number of those reporting receipts of over $1,000,000 annually has increased from 38 to 42, and all of these companies show an increase in gross receipts with one special exception. The average rate of increase in the receipts in 1903 over 1902 was in this group 7.1 per cent.; in the second group, including companies over $500,000, it was 10.7 per cent.; in companies over $100,000 it was 16.5 per cent.; in companies over $50,000 the increase was 9.5 per cent., and in the fifth group of companies, over $25,000, it was 14.4 per cent. The general average increase for 1903 over 1902 was 8.5 per cent. This is certainly a healthy rate of increase and is, we think, somewhat contrary to the general supposition that there had not been much gain during the last year. The figures of the United States Census Office showed that the gross receipts of all the street railway companies for 1902 were nearly $248,000,000. If we apply the rate of 8½ per cent. increase to this, the gross earnings for 1903 for the street railways of America would reach the splendid sum of not far short of $270,000,000.

Such figures as the above are certainly encouraging. There seems to be no limit, in fact, to the expansibility of the street railway industry under the régime of electricity; and as the years go by it will be very interesting to trace the effect of electricity in increasing the traffic of the steam railroads to which it is applied. It would appear, from time to time, that other modes of traction, like the automobile, for instance, or the bicycle, might have some effect on street railway traffic; and we are not yet very far away from the time when some street railway managers thought they were going to lose all their income because so many people had taken to riding bicycles to and from business. The figures of street railway traffic, in fact, certainly keep pace with the growth in population quite steadily, and appear to have a further rate of development of their own, depending very largely upon the increase of facilities. The figures in New York City bring out such an idea and confirm it, especially as soon as the benefits of electricity are thrown into the scale. In 1884 the street car passenger traffic of New York City was barely 185,000,000 passengers, and in 1894 it was only a little over 245,000,000; but it had jumped at the beginning of this year to 612,000,000. There can be no question of the fact that the extension of electrical facilities had a great deal to do with the last enormous stride. Just at present the rate seems to have fallen off a little bit, but this is due again to the fact that the elevated railroads by the adoption of electricity have once more come up to the proper standard of efficiency and competition, so that their figures of traffic which in 1889 showed only 174,000,000 passengers, or almost exactly what they were eleven years before in 1888, had jumped in 1903, after the adoption of electricity, to 246,000,000. Thus, whereas on the elevated roads in the period from 1893 up to 1899 there was actually a steady decrease in traffic, since 1900 and with the employment of electric traction there has been a tremendous rebound, so that the increase on the system in 1904 was 14.51 per cent.

The inference from all these figures is that the opening up of the New York electric underground system this year, while it may again check temporarily the rate of increase of the existing systems, will be found very quickly to develop its own traffic and to yield a good return upon the investment. This will in turn foreshadow the possibilities bound up in the adoption of electricity for the suburban traffic of the New York Central Railroad, where we believe agreeable surprises await the Vanderbilt management in the unsuspected rapidity of development of the suburban region beyond the Harlem River.

Central Station Management.

Elsewhere we print in full the excellent paper read at the recent Boston National Electric Light Convention by Mr. Frank W. Freuauff on the subject of central station accounting. One matter which the paper brings forward is, however, much broader than the subject of mere routine office accounting, namely, that of analyses of cost, whereby for each class of service the fixed and several variable costs are segregated. The central station industry has now reached the stage when it calls for the same refinements in details as to costs as prevail in the great manufacturing industries, and the sooner the situation is realized by managements the better will it be for their personal welfare and for the interests of their plants. In workshops the system of accounting for each item in the cost of a product from the crude material to the finished ware delivered to the distributor dates back a quarter of a century, and has revolutionized manufacturing organization. In the early stages the system was viewed with suspicion by the owner or manager who had been accustomed to the old methods, and was content to rely on general results without endeavoring to isolate and take account of all the factors making toward success or failure. Such as these have all had either eventually to surrender their prejudices or step aside to make place for the more progressive.

A similar situation is rapidly confronting all central station men, and those who do not get into line will find themselves dispossessed by others who realize the oportunity that awaits men who can apply to the central station business the principles that now guide the conduct of other branches of production. From one standpoint, the fact that central stations operate under franchises that exclude competition has not been altogether without its disadvantage, in that there has been no incentive to watch competitors and emulate their successful measures and guard against falling into their errors. Doubtless to this situation is largely due the fact that but a small percentage of the electric lighting stations of this country are on a good dividend-paying basis. In the succeeding issue we shall reprint another Electric Light Convention paper dealing with a correlated question—that of segregating distribution losses, in order that the matter of their reduction may be intelligently dealt with. We venture to say that there is scarcely a central station in the United States now on a non-paying basis that could not round the corner by following intelligently the indications of these two papers, united with systematic solicitation of new business; and as the two investigations would probably point to the possibility of considerable and even large reductions in rates for each successive profitable increase in business, there would be heart in the work.

The Second German-American Cable.

The completion, last week, of the second German cable, connecting Germany with America, is in line with the recent German activities in colonial and ex-territorial development, to which we referred last week, in noticing the proposed German cables in the East. Modern national competition is for trade supremacy. In the seventeenth century, colonies were sought by monarchies for dominion. In the twentieth century colonies are valued only as trade supporters. A colonist is not only likely to make a consumer of home manufactures, but he is also likely to spread about and advertise home manufactures to his neighbors. The nations competed for land in past days. They now compete for business. The establishment of colonies for business is a business in itself. It calls for coaling stations, docks and a huge accessory government mechanism. Moreover, the establishment of colonies gives hostage both to peace and to war. To peace, because order must be kept in the colonies, and the national honor is involved in the colonial government. To war, because in case of hostilities, colonial possessions become most vulnerable. In practice, the maintenance of communication with colonies is vital to their preservation in event of war. At present, the only safe way of preserving communication abroad is by means of a continuous network of submarine cables. Until quite recently, the cable system of the world was almost wholly British. This supremacy beneath the seas has been a strong military weapon. In peace, cables belong to all nations alike. There is no preferential tariff in cable rates. In war, cables belong to the governments where they land, unless captured or removed. America has established her own cables with her Pacific islands. France has her own cables to African possessions, as well as to the American continent. Germany has established her own cables to America, and now seeks to extend them elsewhere. It is probably only a question of time when she will lay cables to her African possessions, her eastern Asian possessions, and to South America. In one sense these cable expansions make for peace, since the investment associated with them is hazarded in war, and makes the advent of war more ominous and less easy.

Power Transmission and Irrigation.

The Institute meeting at Chicago next week, to discuss power transmission, promises to be quite interesting. It has been organized by the Transmission Committee and a number of important topics are to be taken up, details of which were given in these pages. Incidentally, as the Republican National Convention will be in session at the same time, rates of fare are made easy and the engineers can learn a good deal from the politicians about the smooth-running of machinery.

The great art and industry of transmission by electricity that has sprung up and developed in recent years is worthy of this special attention and will certainly take on greater importance from year to year. We are very far from having yet exhausted in this country the possibilities of the great and small water powers upon which primarily the new art is based, and the diligent prospecting of the last five years should soon bear fruit. It is true that in many of our large central station systems and minor aggregates of circuit the transmission part of the problem is by no means the smallest, but the subject essentially is thought of from the standpoint of reclaiming waste hydraulic power.

In this connection we believe that in various sections of the country power transmission and irrigation are destined to become very closely related, so that we may see many companies playing the dual part just as in the lighting field so many supply both electricity and gas. We note, by the way, some striking figures with regard to irrigation just issued by the United States Bureau of the Census. It appears that in 1902 there were no fewer than 134,036 irrigated farms in the United States, having a total acreage of 9,487,077. Every acre thus irrigated is an increase of the wealth of the country. It takes about twenty inches of rainfall for the production of the crops, and irrigation is necessary in all sections where this amount of rainfall cannot be depended upon. The area increased from 1899 to 1902 nearly 22 per cent. The cost of constructing irrigating systems has

amounted to $93,320,452, an average of $9.84 per acre, and the length of main ditches of irrigating trenches is 59,242 miles. The greatest irrigating States are California, Colorado and Montana. California has 1,708,720 acres under irrigation; Colorado, 1,754,761 acres, and Montana 1,140,644 acres. These are figures applying to the arid regions alone. The Mississippi tributaries are drawn upon more heavily for this purpose than any other streams in the country. The systems receiving water from these tributaries have a length of 20,064 miles. It stands to reason that a great deal of the old and new irrigation work must depend upon water received from much higher levels; and in almost every instance there should be a distinct opportunity for utilizing the head in apparatus for light and power, especially with proper systems of water storage.

THE BEAR RIVER POWER PLANT.

Transmission plants are now such commonplaces of engineering that the addition of another to the rapidly lengthening list is seldom an item of essential interest. The plant we describe in this issue, however, is, we believe, unique in that it was installed with the deliberate intention of utilizing the surplus water of an irrigation system during the season of high water. There are various power plants which utilize the artificial falls of a ditch system, put in merely to distribute the water to advantage, but so far as we recollect this is the only instance in which a plant uses unstored surplus and shuts down during a short dry season. Of course such a plan would ordinarily be infeasible, or would be worked only under conditions which permitted extensive use of an auxiliary steam plant. Here, however, the Bear River plant is itself an auxiliary to five other hydraulic plants, together amply capable of delivering all the power needed during the low-load season. It is a water power auxiliary to help out during the long annual peak. There are three steam auxiliaries on the Salt Lake City system, but water being cheaper than steam can be used to great advantage while it is available. The starting of the Bear River plant makes the sixth water power plant of the system.

Salt Lake City is situated in an ancient basin with no near hydraulic powers of any considerable size, and in fact no large powers within a very long radius. Nevertheless, by persistent enterprise enough power has been developed in scattered plants of moderate size to meet most of the local requirements. The six hydraulic and three steam plants are operated in parallel on the low-tension side, and from all accounts pull together with the utmost harmony, thanks to the somewhat flexible connections supplied by the long lines. The whole system is a fine example of utilization of the facilities afforded by Nature in a somewhat ungenerous mood. Hydraulically the novel feature of the plant is the supply of water for the turbines from a huge inverted syphon connecting two main irrigating canals separated by the Bear River bed. This syphon is in part of redwood stave pipe, to which the steel pressure pipes are connected, and by its use water for the plant can be drawn from either canal, or during the irrigation season water can be transferred from one canal to the other. The transmission line is worked at 40,000 volts and is 82 miles long, delivering the output of a pair of 750-kw, three-phase generators. A word may be said here as to the insulators. For these high pressures there is little uniformity of practice, but in this instance massive brown porcelain insulators were chosen and these were individually tested at 120,000 volts before being accepted. A factor of safety was thus secured which should prove sufficient for all ordinary and most extraordinary contingencies. The whole question of high-tension insulators needs overhauling, and until the art is much further advanced than at present, this plan of individual testing, laborious as it is, has much to commend it.

INFLUENCE OF THE LINE ON THE PARALLEL OPERATION OF SYNCHRONOUS MOTORS.

A single synchronous generator on an alternating-current system takes electrical charge of the system in its own way. The moment that another one is added, however, either as a generator or as a motor, there is always a chance for their quarreling and getting out of step. In a perfectly steady régime two synchronous generators running in parallel do not exchange power, and run at the definite uniform phase difference which corresponds to this condition. The moment that a disturbance occurs, either by the pulsation of the prime-mover of one or by some sudden change in load acting dissymmetrically on the two, a change in relative phase is set up whereby a local current is produced between the two generators. The power components of the current will produce torques in the machines, drawing the machines together. By mechanical inertia the two machines will tend not merely to come back to equivalent cophase, but also to swing beyond. If no damping forces were at work, the mutual oscillations about the cophase position would continue indefinitely. Resistance in their local circuit and conductance in magnetically associated circuits, tend to absorb the swing energy from the system and bring the machines into steady cophase (or equivalent cophase for difference of generated e.m.f.).

If then oscillations persist, there must be a persisting periodic source of swing. This source may be either mechanical or electromagnetic. If mechanical, the prime-movers or engines driving the machines pulsate rhythmically, either by the hunting of their governors, or by the periodic fluctuations of driving torque. If the source of disturbance is not mechanical it may be due to hysteresis in the magnetic circuits of the machines. A lag in the magnetic flux behind the m.m.f. of the armatures' magnetic circuits may give rise, under favorable circumstances, to swinging forces, or negative damping, so that the machines will not come into cophase, but will swing apart until the magnitude of the damping actions evoked by the swing balances the disturbing forces; or even, in the worst cases, until the machines swing themselves out of step. The frequency of such free electromagnetic oscillations is independent of the governors of the driving engines, and depends only upon the moments of inertia of the rotors and upon the constants of the local electrical circuit. On the other hand, when the oscillations are of mechanical origin, the period is set by the mechanics of the governing systems and is only affected in subsidiary degree by the electric circuit.

When the swinging is of electromagnetic origin, the magnitude of the restoring forces depends both upon the magnitude and upon the angle of the impedance in the circuit connecting the two armatures. If the impedance is large, either by reason of large resistance or of large reactance, the restoring forces will be small. If the impedance in the circuit is small, the restoring current will be relatively powerful, but the effective component will be the e.m.f. component. Cases may occur in which the resistance of the circuit, as affected by the transmission line, may materially influence the pendulum action, so that the same pair of alternators which would only swing through an electric amplitude of, say, 20 amperes, when operating in parallel side by side, might swing through an electric amplitude of 200 amperes when operating in parallel with the impedance of a transmission line between them. The interesting papers printed in the *Transactions* of the Italian Association of Electrical Engineers, as referred to on page 1155 of this issue, bear upon this interesting condition. The elimination of the danger of excessive electromagnetic pendulum action lies in the design of alternators of insufficient armature reaction and hysteretic lag to overcome the damping forces under any conditions of excitation and line impedance.

International Electrical Congress.

Acceptances of membership in the International Electrical Congress, to be held September 12-17 in St. Louis, now number over 1,700, and more than 160 specially invited papers are promised. One thousand certificates of membership have been issued to those who have become members by sending in their subscriptions and about 100 more certificates are about to be issued.

Efforts are being made to secure the MSS. of as many of the 160 papers as possible by the first of July, in order to have them printed in advance for distribution among the Congress members at St. Louis.

The programmes scheduled for Sections D and E are given below. The similar programmes of Sections A, B and C have appeared in preceding issues.

All communications concerning the Congress should be addressed to the general secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.

SECTION D—ELECTRIC POWER TRANSMISSION.

Chairman, Mr. Charles F. Scott; secretary, Dr. Louis Bell.

Name of Author.	*Title of Paper.*
Sig. E. Bignami,	Electrical Transmission Plants in Switzerland.
H. M. Hobart,	Conditions Conducive to Economy in Motor Design.
Mons. Maurice Leblanc,	Transmission of Alternating Currents over Lines Possessing Capacity.
Prof. G. Mengarini,	Utilization of Hydraulic Powers in Italy.
F. G. Baum,	High-Potential, Long-Distance Transmission and Control.
F. O. Blackwell,	The Tower System of Line Construction.
H. W. Buck,	The Use of Aluminum as an Electrical Conductor.
V. G. Converse,	High-Tension Insulators.
M. H. Gerry, Jr.,	Line Construction and Insulation for High Tensions.
L. M. Hancock,	Bay Counties Transmission System.
R. L. Hayward,	Some Practical Experiences in the Operation of Many Power Houses in Parallel.
J. F. Kelly and A. C. Bunker,	Long-Distance Power Transmission.
P. M. Lincoln,	Transmission and Distribution Problems Peculiar to the Single-Phase Railway System.
R. D. Mershon,	The Maximum Distance to which Power Can be Economically Transmitted.
P. N. Nunn,	Pioneer Work of the Telluride Power Co.
J. S. Peck,	The High-Tension Transformer in Long-Distance Power Transmission.
Dr. F. A. C. Perrine (representing Nat'l Elec. Lt. Assoc.),	American Practice in High Tension.
Dr. C. P. Steinmetz (representing American Inst. Elec. Engs.),	Theory of Single-Phase Motors.

SECTION E—ELECTRIC LIGHT AND DISTRIBUTION.

Chairman, J. W. Lieb, Jr.; secretary, Gano S. Dunn.

Prof. André Blondel,	Impregnated Arc Light Carbons.
Herr Max Déri,	Single-Phase Motors.
Herr E. de Fodor,	Rates for Electricity Supply.
Sig. Ing. E. Jona,	Insulating Materials in High-Tension Cables.
Prof. W. Kübler,	Upon a Means for Compensating the Series Connection of Induction Motors.
Herr Karl Roderbourg,	Storage Batteries.
Sig. Ing. Guido Semenza,	Commercial Limits of Electric Transmission with Special Reference to Lighting Service.
Dr. G. Stern,	The Superiority of the Alternating Current for Distribution in Large Cities.
Dr. W. Wedding,	Measurements of the Energy of Light and Heat Radiation from Electric Light Sources.
Arthur Wright,	Recent Improvements in Electrolytic Meters.
Prof. S. P. Thompson,	(Subject to be announced later.)
B. A. Behrend,	The Testing of Alternating-Current Generators.
George Eastman (representing Nat. Elec. Liht Assoc.),	Protection and Control of Large Light-Tension Distribution Systems.
W. C. L. Eglin (representing Assoc. Edison Illum. Cos.),	Rotary Converters and Motor Generators in Connection with the Transformation of High-Tension Alternating to Low-Tension Street Current.
W. L. R. Emmet,	The Effect of Steam Turbines on Central Station Practice.
Louis A. Ferguson (representing Assoc. Edison Illum. Cos.),	Underground Electrical Construction.
Gerhard Goettling (representing Assoc. Edison Illum. Cos.),	Storage Batteries as an Adjunct to Central Station Equipment.
G. Ross Green (representing Nat. Elec. Lt. Assoc.),	American Meter Practice.
Caryl D. Haskins,	Metering Efficiency on Customers' Premises.
Francis Hodgkinson,	Steam Turbines.
John W. Howell,	Incandescent Lamps.
Philip Torchio,	Distributing Systems from the Standpoint of Theory and Practice.
W. F. White,	The Selection of a Distributing System for a Large City.

India Rubber in the United States.

It is stated that imports of india rubber into the United States in the fiscal year about to end will exceed by far those of any earlier year, and will amount to over $40,000,000 in value. The demand for this article of exclusively foreign production for use in manufacturing has increased very rapidly in recent years, and the imports in the present fiscal year, as shown by the Department of Commerce and Labor through its Bureau of Statistics, will amount to about 60,000,000 pounds, valued, as already indicated, at fully $40,000,000. This rapid increase is apparently due, in a large degree, to the increasing use of this material for insulation as well as for tires of electric vehicles and automobiles of various classes, though in other lines of manufacture the demand is also very great.

The rapid growth in the use of this article of manufacture in the United States is illustrated in the fact that the total value of india rubber and gutta-percha imported in 1870 was less than $3,500,000; in 1880, $9,500,000; in 1890, $15,000,000; in 1900, $31,000,000, and in 1904 will be fully $40,000,000. The increase in quantity has not been so rapid as the increase in value, owing to the fact that prices have advanced materially by reason of the greatly increased demand of the various manufacturing sections of the world, especially the United States.

In 1880 the quantity of rubber imported into the United States amounted to 17,000,000 pounds, valued at $9,500,000, making the average price about 55 cents per pound. In 1890 the quantity imported was 34,000,000 pounds valued at $15,000,000, or slightly less than 50 cents per pound. In 1900 the quantity imported was 49,000,000 pounds valued at $31,000,000, or about 63 cents per pound; while in 1904 the record of the ten months for which figures are now available shows an average value for rubber imported of 68 cents per pound. In addition to this, however, large quantities of material utilized in conjunction with india rubber are now imported.

Importations of "gutta-joolatong," a product of India, which is used in certain industries as a substitute for india rubber, now average more than a million pounds a month, while importations of old and scrap india rubber to be remanufactured amounted to over fifteen million pounds in the ten months of the fiscal year for which a record is now at hand. These importations of old and scrap rubber for remanufacture and of gutta-joolatong as a substitute in certain lines of work are comparatively new and have only been reported by the Bureau of Statistics as a separate item during a very recent period.

Bear River Power Plant and Utah Transmission Systems—I.

THROUGHOUT all sections of the West the development of electric power from mountain streams goes hand in hand with great irrigation enterprises; and in many cases, especially in Colorado, Utah and California, the tail race of a hydroelectric plant is the headworks of an irrigation system supplying thousands of acres of rich soil with water through extensive canals. Perhaps none of these combinations of power generation and irrigation is more interesting than that recently put in operation by the Utah Sugar Company on the Bear River in Northern Utah, and a noteworthy fact in connection with it is that the usual conditions are reversed, inasmuch as the irrigation interests in this instance have the prior right to the water and electric power is developed only when there is a surplus of water over the needs of the lands below. In other words, electricity is produced as a by-product. The conditions are as follows:

Some 20 years ago the present hydraulic development of the Bear River was made. It consisted in building a diverting dam at the upper end of the Bear River Canyon. This dam diverts water at each side of the river into separate canal systems. The two canals, one on the west bank and one on the east bank of the river, carry the water for a distance of two miles down the canyon through a series of tunnels, flumes and masonry-supported ditches. They emerge at the lower end of the canyon at a height of 115 ft. above the river and about 1,000 ft. apart. From that point the canals diverge, each dividing a little farther on into branches and laterals, thus irrigating several thousand acres of land. These canals are now controlled by the Utah Sugar Company, which operates a beet sugar factory supplied from the large sugar beet farms of the locality.

Although for some time aware of the possibilities on this river, the company had not taken steps to develop power because it had no market. With the rapid growth of Salt Lake City, however, in recent years, there has come a greater demand on the plants of the Utah Light & Railway Company, so the latter was glad to enter into a contract for the entire output of the new station. The development of the power does not lessen the quantity of water available for irrigation, because only the surplus water is used at the station. The canals below the canyon can carry the entire flow of the river only during the period of extreme low water, which lasts but a few weeks in August and September. During the remainder of the year there is more water than is needed for irrigation purposes, and it is this surplus water which is used to generate electric power. The shutting down of the plant during the few weeks in summer comes at a time when the power can best be spared in Salt Lake City, as the lighting and power loads are the lightest at that season, and can easily be carried by the other plants of the system.

The power house is situated on the east bank of the river just at the lower mouth of the Bear River Canyon, and at a point about four miles north of Collinston, Utah. Here a unique plan has been adopted to utilize the water from either canal, which consists in connecting the canals by an inverted syphon and taking out the water for the turbines at the lowest point. The general arrangement of the syphon and power house is shown in the plan and elevation in Fig. 4, and it may also be observed in the illustrations, Figs. 1 and 2.

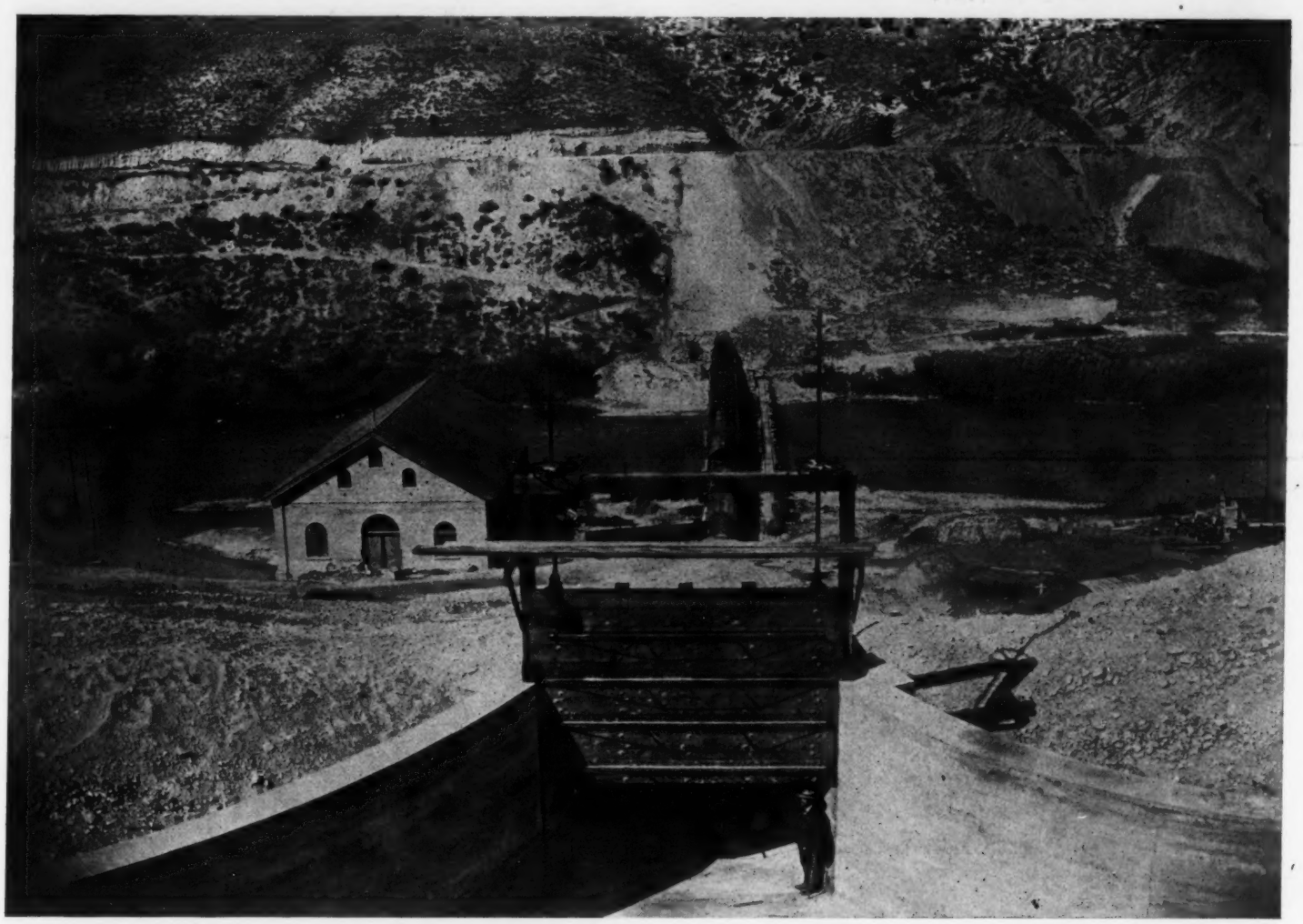


FIG. 1.—VIEW OF POWER HOUSE AND SIPHON SHOWING EAST INTAKE TO SIPHON PIPE.

The syphon has an inside diameter of 8 ft. and is built of California redwood, the Excelsior Wooden Pipe Company, of San Francisco, having the contract for the work. Each pipe is connected with its respective canal by means of a concrete turnout, which has been carefully designed to prevent loss of head from water eddies, and before entering the pipe the water passes through an iron screen and large wooden gate, which is raised and lowered by means of hand wheel screens from a platform above, as shown in Fig. 3. Fig. 5 is a view of the west canal and inlet.

The pressure pipe on the east bank is 322 ft. long and is laid at an angle of 17° to the horizontal, while the west pipe is 195 ft. long and is laid at an angle of 29°. At the lower ends of the pipes and connecting with the horizontal part of the syphon are specially-constructed, steel-riveted elbows, securely anchored on converter

peers. That on the west bank is shown in Fig. 6. Between these elbows is 418 ft. of straight pipe, the west portion crossing the river on a 225-ft. steel three-span bridge (Fig. 2) resting on concrete and stone piers. Opposite the power house, placed 70 ft. apart, are two steel sections, 15 ft. long, from which steel penstocks, 66 in. in diameter, lead to the turbines in the power house. Figs. 5, 6 and

FIG. 2.—POWER HOUSE AND SIPHON.

7 illustrate details of the wooden pipe and also the method of building it. Since these photographs were taken the pressure pipes have been covered with earth and the horizontal portions are protected from the weather by a wooden sheathing.

By means of this arrangement of pipes water for the turbines may be drawn from either canal, or during the irrigation season, if either canal should break through a retaining wall in the canyon, as sometimes happens, the portion of the canal below the canyon can be supplied from the other canal through the 8-ft. syphon, and thus preserve the crops in the valley until the damaged canal is repaired.

The bottoms of the two canals are on the same level, but it is estimated that a difference of head of one foot will produce a flow through the pipe of about 320 cu. ft. per second. Thus, if the west canal be filled to a depth of six ft., and the water in the east canal

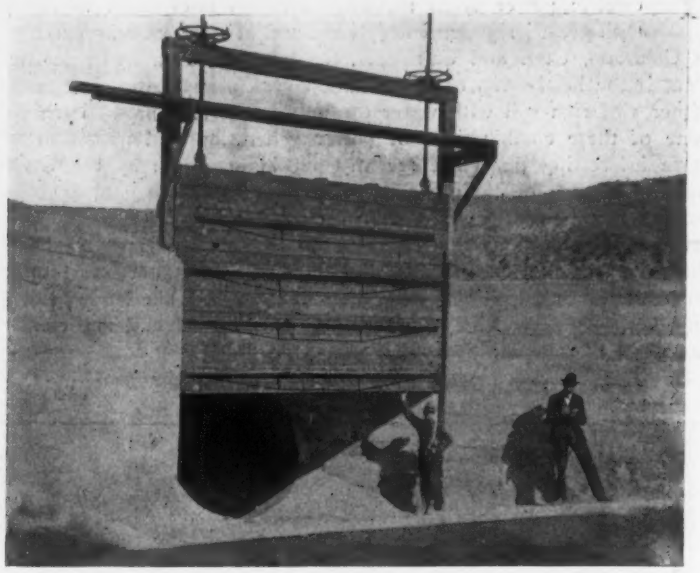


FIG. 3.—ENTRANCE TO EAST INTAKE AND GATE.

stands at a depth of 5 ft., there should be just enough water passed through the syphon to supply all the water which the east canal will carry at 5 ft. depth.

POWER HOUSE.

The power house is substantially built of brick on concrete foundations carried down to bed rock. The roof is supported by timber trusses and consists of standing-seam tin roofing laid on 2-x-6-in. roof boards, which are nailed to 4-x-12-in. purlins. The building is 100 ft. long and 60 ft. wide; 40 ft. from the north wall is a row

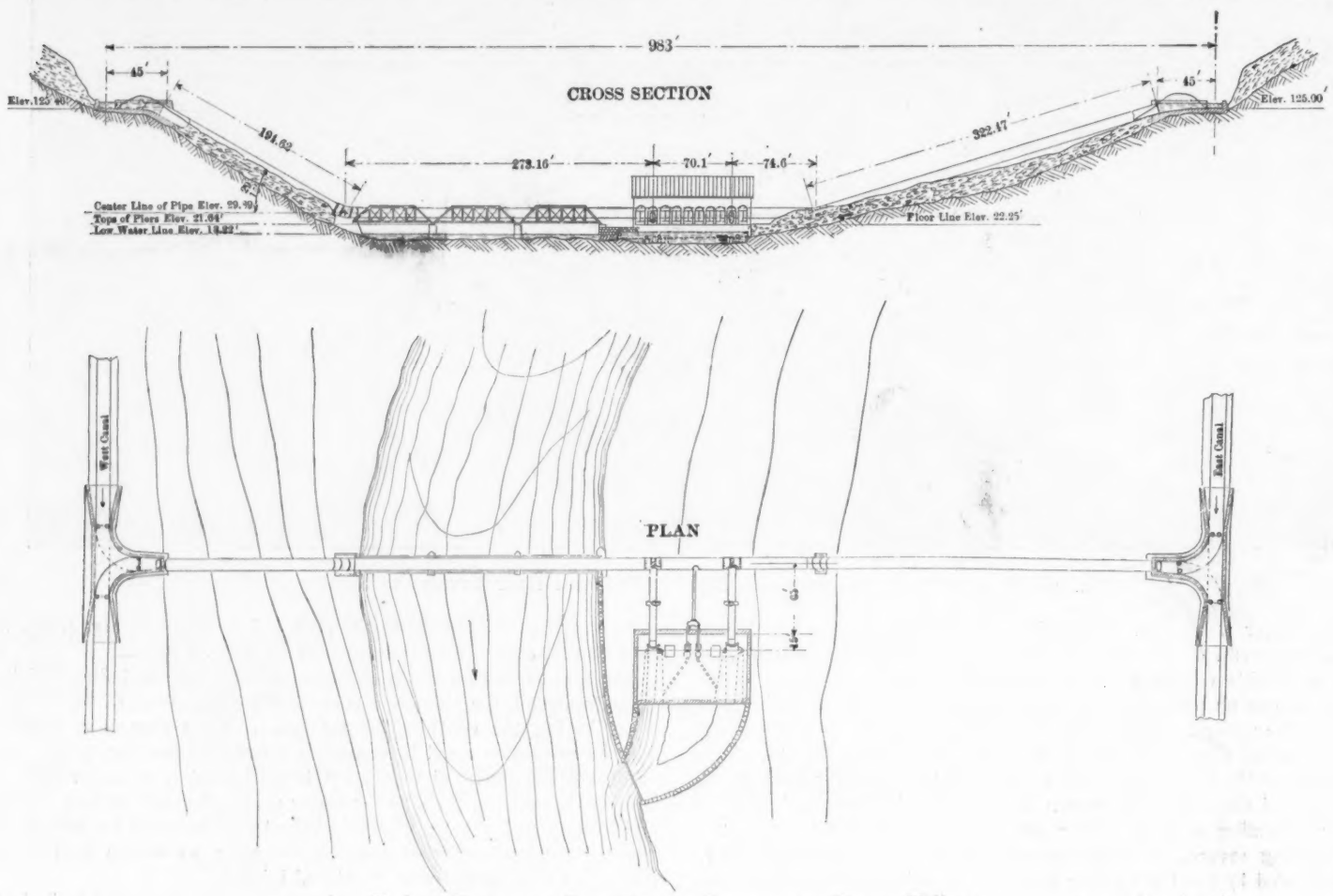


FIG. 4.—PLAN AND ELEVATION OF SIPHON AND POWER HOUSE.

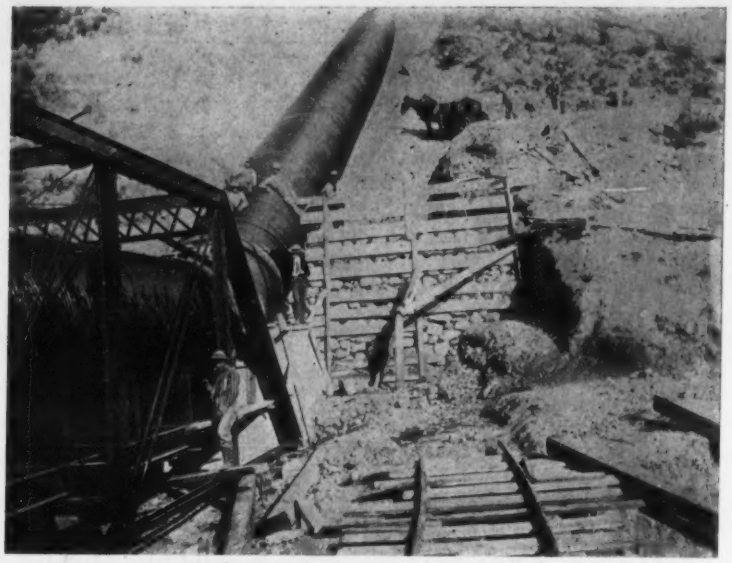


FIG. 5.—WOODEN STAVE PIPE ON WEST BRANCH AND END OF BRIDGE.

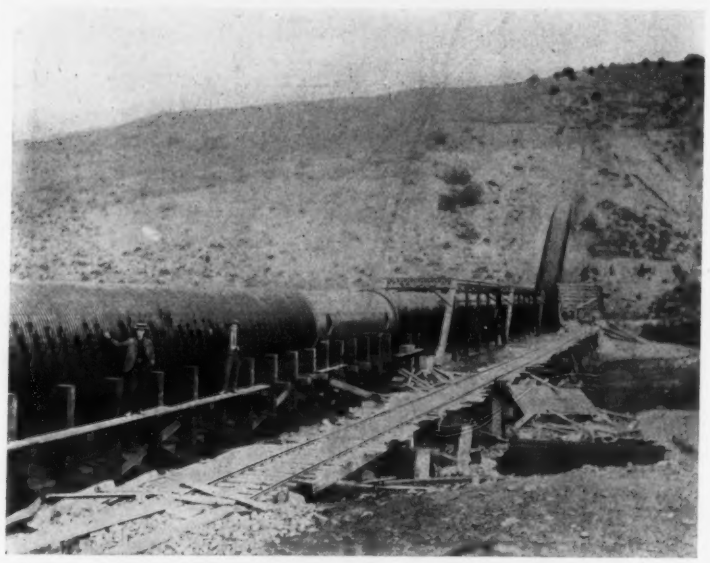


FIG. 6.—WOODEN STAVE PIPE AND BRIDGE.

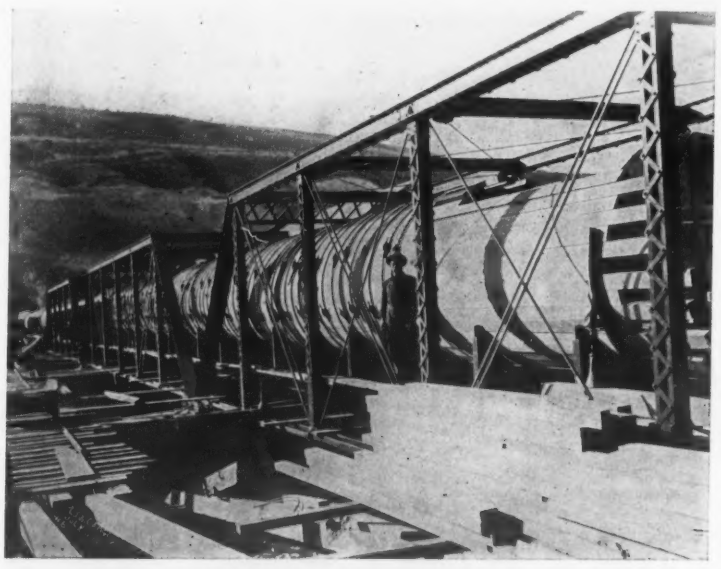


FIG. 7.—BRIDGE AND PIPE.

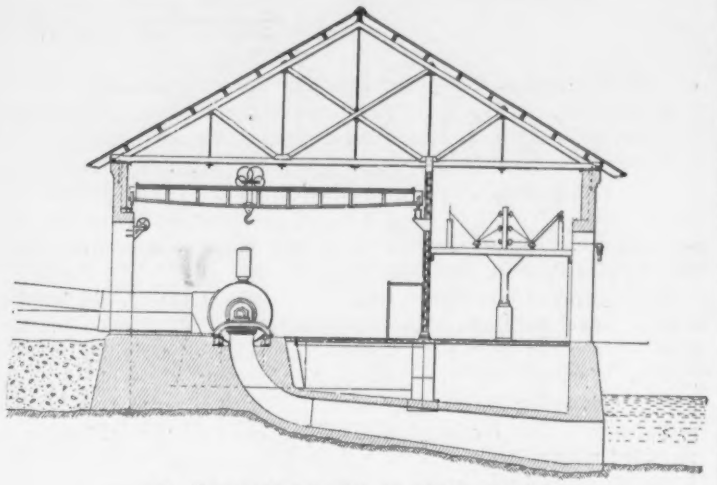


FIG. 8.—CROSS-SECTION OF POWER HOUSE.

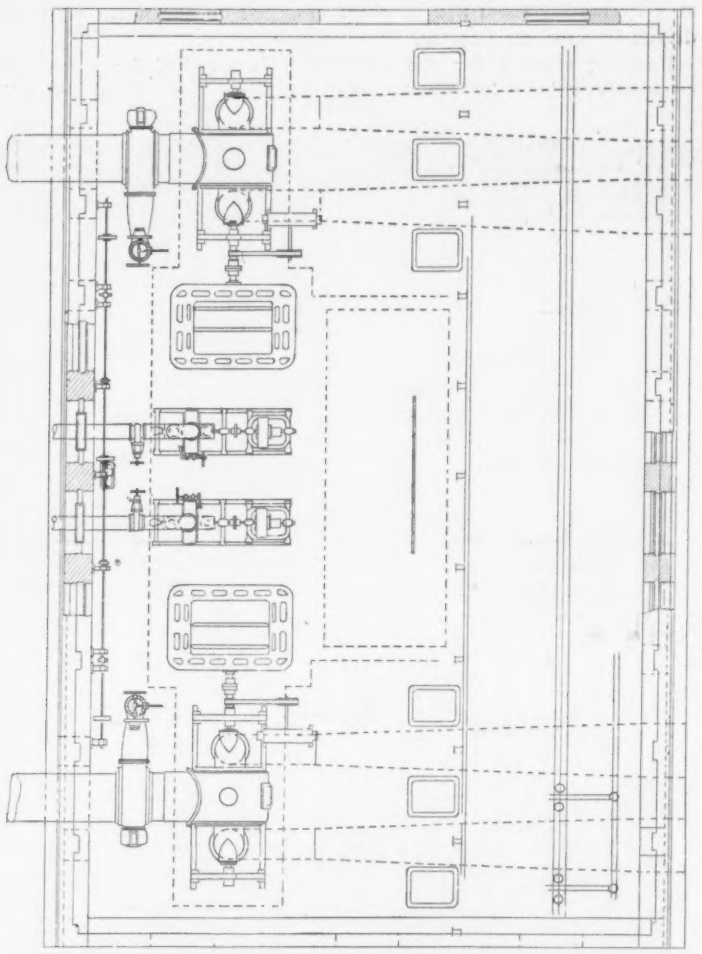


FIG. 9.—PLAN OF POWER HOUSE.

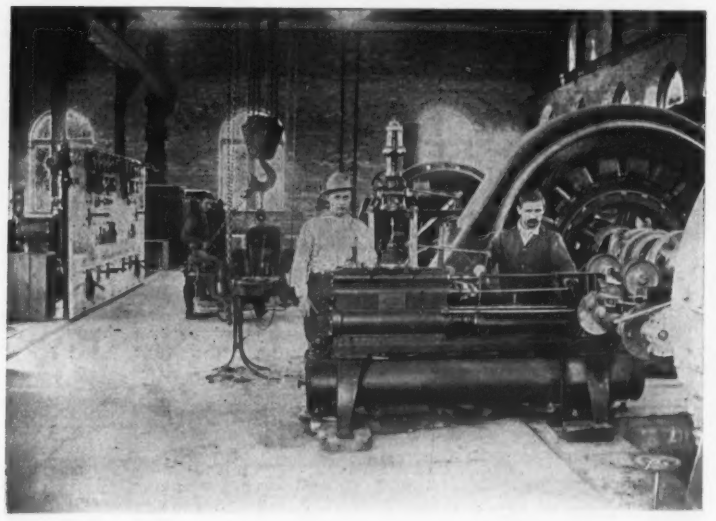


FIG. 10.—VIEW OF INTERIOR OF BEAR RIVER POWER PLANT.

of steel columns dividing the building into two portions. In the larger portion, which is served by a 20-ton Whiting crane, are located the turbine, generators and switchboard, while the other space is given up to transformers and high-tension switching apparatus. Figs. 8 and 9 show respectively the cross-section and plan of the power station. The building has no basement except under the switchboard. All low-tension wires and cables are carried under the concrete floor in clay conduits.

The hydraulic equipment consists of two 1,400-hp, double-discharge Leffel turbines, each mounted at the end of a 66-in. steel inlet pipe. Each turbine is connected by means of a rigid shaft to a 750-kw Westinghouse revolving-field, 2,300-volt, three-phase alternator. Governing is accomplished by Lombard governors, and levers are also provided for hand regulation. Each of the inlet pipes is provided with a Rensselaer gate valve located just inside the power house so as to be in reach of the 20-ton crane. These valves are among the largest ever made, weighing 17 tons each. They are operated by belting from a 2-in. shaft mounted on the north wall and driven by an electric motor.

Exciting current for the alternators is supplied by generators separately driven by small Leffel turbines, for which water is brought through a 24-in. pipe directly from the large syphon pipe. This pipe branches outside the building into two 18-in. pipes, which supply the turbines. The exciters are thus driven independently of the large generators, and better regulation and greater reliabiility are, therefore, afforded. Figs. 10 and 11 are views of the interior of the power house, showing the large units and switchboard.

The discharge water from the turbines is carried by means of four draft tubes, each leading down with a long 90-degree vertical bend, to a flaring concrete tunnel under the power house floor. These tunnels all terminate in a common tail race and are so proportioned that the water is brought almost to rest before being discharged, so that as much as possible of its energy is utilized. The draft tubes of the exciter turbines discharge into the two inside tunnels.

The nine-panel marble switchboard which receives the 2,300-volt current from the generators has mounted upon it the necessary oil switches and indicating and recording instruments. Three oil-insulated transformers raise the voltage from 2,300 to 40,000 volts. These transformers are set 10 ft. apart and each is exactly opposite one of the 10 windows in the south side of the power house. After leaving the high-tension side of its transformers, each wire of the three-phase circuit passes, without lateral deviation, successively to a static interrupter, a high-tension switch of special design, a low-equivalent lighting arrester, and finally out of the window through a long glass bushing. This window consists of two sheets of heavy plate glass six inches apart, with holes in the centers for support of the bushing. All electrical apparatus in the power house is of Westinghouse manufacture. The transmission features of the plant will be considered in a concluding article.

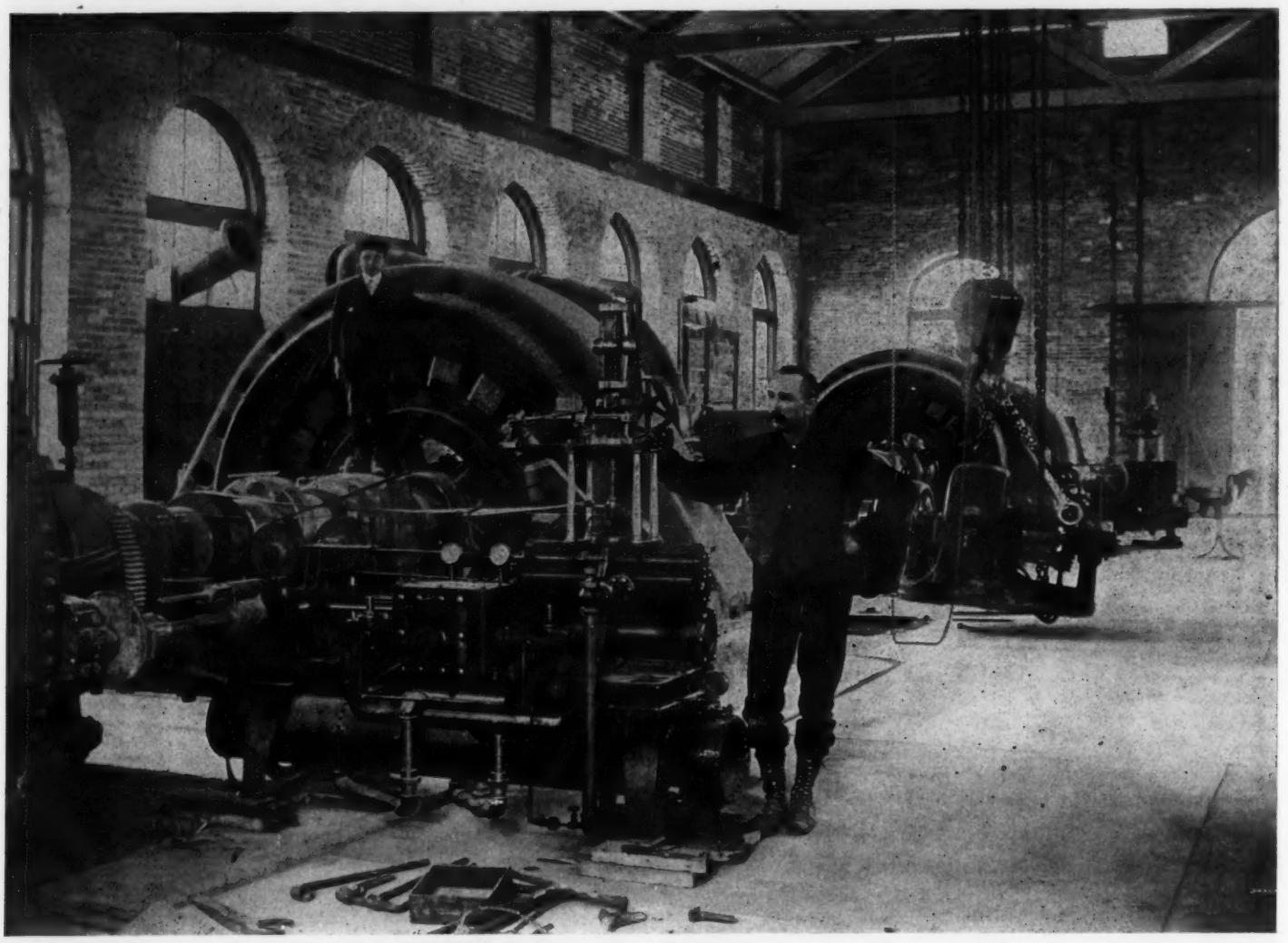


FIG. 11.—VIEW OF INTERIOR OF BEAR RIVER POWER HOUSE.

Wireless Telegraphy on Russian Ships.

A St. Petersburg dispatch states that the admiralty has installed Siemens & Halske wireless telegraph apparatus on five battleships and the cruisers *Aurora* and *Dmitri Donskoi*. All of the ships that are being fitted out on the Baltic Sea are, it is stated, also being equipped in a similar manner. The Russians appear to have changed their attitude toward wireless telegraphy, since it is but a few weeks ago that a ukase was promulgated against the use of it by neutrals within the zone of hostilities. The operation of wireless systems by the contending forces, and by newspaper correspondents, will no doubt make things interesting, and there will be a clash of forces in the air as well as at sea and on land.

Geysers by Searchlight.

A powerful battleship searchlight has been put in operation in Upper Geyser Basin, at the Yellowstone National Park, to show the working of the geyser at night. The effect, it is said, is marvelously beautiful and hereafter the searchlight illuminations of the active geysers will be a feature in the National Park.

Influence of the Line on the Parallel Operation of Synchronous Motors.

The Italian Association of Electrical Engineers has printed in its *Transactions* two interesting papers on the influence of the line on the parallel operation of synchronous motors, one by Signor Rebora and the second by Signor Guido Semenza. We give below abstracts of these papers.

Signor Rebora, in introducing his paper, says that it is generally believed that the distance between power houses is not a factor in the satisfactory operation in parallel of alternators, and the object of his paper is to give the result of experiments which will warn electrical engineers to be at least cautious in this matter.

Referring to Fig. 1, *A* is a new power house, built to be operated in parallel with a power house, *B*, 11 miles distant. *A* has three

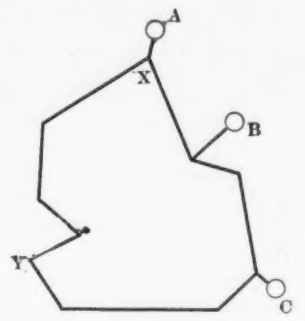


FIG. 1.

three-phase units, of 500 hp each, 360 r.p.m., 6,000 volts, 48 cycles, driven by Pelton wheels. The excitation is supplied by two special groups of turbine dynamos. *B* has three three-phase units of 250 hp each, 480 r.p.m., 6,000 volts, 48 cycles, driven by Pelton wheels. An exciter is belted to each generator.

The line has a total developed length of 50 miles and feeds lamps, induction motors and two 100-hp synchronous motors at *C*. All the generators, as well as the synchronous motors, are of the same type (revolving field, laminated poles, open slots), and their characteristics (saturation curve and short-circuit current) were found to be quite similar. When the new power house, *A*, was ready for operation it was attempted to run the generators of *A* in parallel with the generators of *B*, but in vain. *B* was then cut out, and current was sent from *A* to *C*, but it was impossible to operate the synchronous motors there, though they had been working satisfactorily when commanded by the generators of *B*. Lamps and asynchronous motors were not affected at all by the change of the power house. Signor Rebora then started a series of experiments to find out the cause of the trouble.

While the power house of *B* was working on a certain load of lamps and induction motors, he tried to connect to the line one of the generators of *A*, but as soon as the connection was made the main ammeter, the voltmeter and the exciter ammeter (both at *A* and *B*) started to oscillate violently, with a periodicity of 100 throws per minute, as did also at the same frequency the turbine, the governors and the water in the conduits.

He noticed at once that the oscillations originated in the electrical part of the system. He repeated the experiment several times, changing all conditions which could affect the operation, but the result always remained the same, and did not vary when he tried to couple one of the generators of *B* (250-hp) to one of the generators of *A* (500-hp), the latter being started first. Then he connected the machines of *A* and *B* to the line *A, X, B*, alone—at no load—and under these conditions the generators kept in step. Subsequently he tried to run one of the motors of *A* as a synchronous motor; after coupling it (at no load) as a generator, he shut off the water from the turbine and the machine kept on running as a synchronous motor operated by *B*. However, he was not able to reverse the test, viz.: to run a machine of *B* as a synchronous motor operated by *A*. The coupling of *B* in parallel with *A* as a generator at no load was easily done, but it was sufficient to touch the hand wheel of the turbine driving *B* to start at once the oscillating motion.

Signor Rebora gives an account of a series of schemes that he used in order to run *A* and *B* in parallel, but every one of them failed. After systematically studying and eliminating every reasonable cause of the phenomenon, attention was directed to the influence of the line.

The three conductors which constitute the simple three-phase line in question are supported on wooden poles at the vertices of an equilateral triangle, having a side of 10 in. The following tables give the lengths, resistance and reactance of the different stretches of the line. The capacity is negligible:

	Kms.	Resistance per Wire in Ohms.	Reactance per Wire in Ohms.
A X Y C.	45.00	25.55	13.58
A X B.	18.100	15.45	5.67
A X B C.	31.500	22.75	9.75
B C.	13.400	7.3	4.10
B X Y C.	50.820	37.70	15.75

The configuration of the line suggested an interesting test. First, the motors in *C* were connected directly to *B* through the line *B C* only, and their operation was satisfactory and stable. Then the stretch *B C* was interrupted and current to *C* passed through the line *B X Y C;* the operation became impossible and the pendulum motion appeared. The latter test differed from the former in the length of line only. In the first case the resistance per wire was 7.3 ohms and the reactance 4.10 ohms; in the second the resistance was 37.7 ohms and the reactance 15.75 ohms. This made plain that the regular operation of generator and motor depended on the length of the line between them. A remarkable feature was that even during the pendular vibrations the machines did not fall out of phase.

Signor Rebora repeated his experiments in another plant with very large machines. A sketch of the line is given in Fig. 2. It was

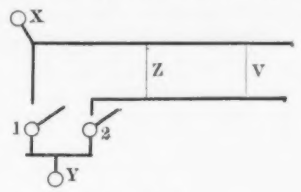


FIG. 2.

possible to use three lengths of line between the generator *X* and the synchronous motor *Y*, viz.: *X Y, X Z Y, X V Y*. The resistances per wire were as follows:

	Kms.	Resistance per Wire in Ohms.
X Y.	12	8
X Z Y.	48	58
X V Y.	84	108

The following experiments were made: (1) Switch 1 was closed (12 km. of line and 8 ohms) and the running in parallel was satisfactory. (2) The current was taken through *X V Y* (108 ohms and 84 km.) and the characteristic pendular motion made its appearance. With the switches 1 and 2 the "hunting" would be started and stopped at pleasure.

When the machine *Y* was operated through the line *X V Y*, the closing of switch 1 was sufficient to damp and eliminate the oscillations, while by closing 2 and opening 1 the vibrations increased up to their full amplitude. In this test, however, it was found that hunting could be stopped by a certain value of excitation; but a further lengthening of the line would probably reproduce the phenomenon, steadily, at any excitation.

Naturally this question presented itself: What influence had respectively the self-induction and the resistance of the line? In order to easier carry out experiments, Signor Rebora made his test on two alternators in the same power house connected through an artificial resistance, inductive and non-inductive, and gives the following results of his observations: Alternators and synchronous motors assume at no load or full load a pendular motion when the resistance of the line between them reaches a certain value. Experimentally, it is difficult to find this exact value, but some limits are obtainable between which the operation becomes unsteady. The self-induction of the line has no important effect on the machines. The phenomenon is affected by the magnetic and mechanical elements of the machines, such as the construction of poles (laminated or solid) the degree of saturation, the resistance and reactance of the windings and the inertia of the rotating part.

The experiments started by Signor Rebora have been continued by Signor Semenza, who gave an account of his work in a paper presented in December, 1903, before the Associazione Elettrotecnica Italiana.

Signor Semenza has carried out two series of experiments. In the first he used two alternators of 300 kw, 42 cycles, 420 r.p.m., 3,550 volts in the same power house, driven by direct-current motors fed by a storage battery. This was an almost ideal condition of

operation and the results of the test correspond exactly to Signor Rebora's observations, as follows:

(1) The resistance of the circuit connecting the two alternators has the effect of producing under some conditions a pendular motion. (2) The amplitude and the period of the vibrations increase with the resistance of the circuit. (3) After a certain limit of the resistance the machines fall out of step. (4) The pendular oscillations have no apparent cause, but appear almost automatically and increase gradually. (5) The phenomenon differs in the case of both machines running as generators from the case of one machine running as generator and the other one as motor.

The second series of tests was carried out on a synchronous motor of 165 kw, 42 cycles, 3,600 volts, 315 r.p.m., connected to the main bus-bars of the plant of Milan, the power of the motor being negligible in comparison with the power of the generators. The results of the experiments were as follows: (1) The amplitude of the oscillations is the greater the farther from the position of $cos\ \phi = 1$ the machine is operated. (2) With the excitation corresponding to $cos\ \phi = 1$ there is no tendency to the pendular motion even with high resistances of the circuit. (3) The reactance of the circuit has decidedly the effect of decreasing the amplitude of the vibrations. (4) In the condition of $cos\ \phi = 1$ the oscillations stop rapidly. (5) The frequency of the oscillations do not seem to have any connection with the stability of the operation.

Mr. Semenza gives the following explanation of the phenomenon: Let us recall the vector diagram of the e.m.f's of two alternators, running in parallel, at no load. If their e.m.f's are the same and the speed of their prime-movers is identical and the regulation is perfect, the diagram is reduced to one straight line. But these ideal conditions are never reached in practical operation, and the diagram is as in Fig. 3.

The two e.m.f's, $O\,E_1$, $O\,E_2$, form an angle, α, and a difference of potential, E_1, E_2, exists at the terminals of the circuit formed by

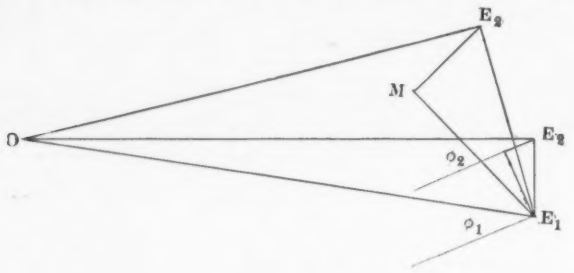


FIG. 3.

the two armatures of the alternators and the line connecting them. A current will flow, determined by the impedance of that circuit. If $E_2M = ir$ and $M_1E_1 = 2\pi n\,Li$ (r and L being the resistance and the reactance of the circuit) the current, i, will have the direction E_2M, and the angles ϕ_1 and ϕ_2 will represent the difference of phase between this current, i, and the e.m.f's of the generators. Now, as far as the resistance and the reactance will not change, the triangle, E_1, E_2, M, will remain similar to itself.

If instead of two generators we consider the case of a synchronous motor connected to bus-bars and the power of the motor is negligible in comparison with the power of the generators, the diagram does not change, but $O\,E_1$ represents the voltage at the bars and $O\,E_2$ the e.m.f. of the motor, and r and L include the resistance and reactance of the motor and of the line connecting it to the bars.

The diagram refers either to single-phase or three-phase machines, if in this latter case we assume that $O\,E_1$ and $O\,E_2$ represent the voltages between the terminal of each phase and the center of the star.

It must be remembered that the current given out by generators running in parallel or taken in by synchronous motors varies with the intensity of the current of excitation, as it is shown by the well-known V curves.

In our vectorial diagram the variation of the value of the exciting current is represented by a shortening or lengthening of $O\,E_1$. When $O\,E_1 = O\,E_2$ and the machines run free, the angle between the two e.m.f's is very small and the direction of the current E_2M is very close to the direction of the e.m.f; the resultant e.m.f., E_1, E_2, reaches a value sufficient to generate the necessary current to supply the power for driving the motor, and since $cos\ \phi_2$ is nearly unity, this current is very small.

But when $O\,E_2$ is different from $O\,E_1$ the angle ϕ increases and consequently the armature current also increases, owing to the fact that the triangle, E_1, M, E_2, must remain similar to itself. This current may lag or lead, depending on the excitation. To be more rigorous, it would be necessary to distinguish the position of $cos\ \phi_1 = 1$ from the position of $cos\ \phi_2 = 1$, but practically these positions are so close together that they can be assumed as coinciding. If the impedance of the circuit remains constant, but the ratio between resistance and reactance changes, the triangle will assume a different form.

By increasing the resistance, the angle E_1, E_2, M will decrease and consequently ϕ_2 will increase, while by increasing L ϕ_2 will decrease. This shows that the resistance and the reactance have an opposite action on the internal displacement of phase of the motor, and it may be easily seen that the resistance calls for a more peaked V curve (this curve is plotted with the amperes of excitation as abscissæ and the amperes of the armature as ordinatæ), while the reactance tends to smooth it. By considering the V curve it can be noticed that in the region of low excitation a point can be reached where the curve becomes vertical or bends backward, and this represents a limit of excitation, at which the motor can no longer keep in step, and the corresponding current will be the smaller, the higher the reactance of the circuit and the lower its resistance.

These deductions will be explained much better by looking into the physical side of the phenomenon. Let us consider a three-phase synchronous motor. The current flowing in the stationary armature sets up a traveling field which drags the inductor. If the excitation corresponds to the minimum input of current, the axes of the poles of the inductor coincide with the axes of the armature field. But if we change the amount of the excitation or we accelerate the rotor, the axes of the poles are shifted, a heavier current is allowed to rush in the armature, the armature field is intensified, and a torque is produced tending to bring back the poles to their former position. This is the principle of the running in parallel of alternators. Furthermore, since the intensity of the armature field may be assumed as proportional to the current, and the e.m.f. of the motor is generated by the flux of the rotor, this synchronizing action is $E_2\ i\ cos\ \phi$. This expression actually represents the power required to compensate the losses of the motor, which is explained by the fact that the action of bringing back the rotor to its normal position corresponds to a variation of kinetic energy—that is, corresponding to a positive or negative work done by the motor. The same thing happens in the case of two alternators running in parallel, every relative displacement between them tending to retard the machine which has been accelerating and to accelerate the machine which has been retarding. Of course, there is a limit; there is a certain angle of displacement, after which the synchronizing action decreases.

This angle is $E_1\,E_2\,M$, and its tangent is $\dfrac{2\pi n\,L}{r}$, which shows again the opposite influence of the resistance and the reactance.

These graphic representations which make so simple the study of the alternating-current phenomena, have generally the fault of neglecting many of the essential elements. In fact, we have assumed the currents as sinusoidal and they are not; we assumed the reactance of the circuit as constant, while it changes with the position of the poles, the amount of the excitation and the value of the armature current; finally, an important element has been neglected, namely, the reaction of the armature.

As to the pendular oscillation on a three-phase synchronous motor, let us assume that the e.m.f. of the motor forms an angle α with the e.m.f. of the bus-bars, and that an external impulse has the effect of increasing the angle α; as we have seen, a torque will be produced tending to retard the rotor. But while the acting torque varies instantaneously with the reciprocal position of rotor and stator, the variation of the speed follows this torque, lagging behind it on account of the inertia of the mass. We have then the sufficient conditions to produce a pendular motion. In the same way the pendulum keeps up its motion, for when the mass has reached the lowest point and the horizontal component of the gravity is reduced to zero the mass maintains the speed acquired in falling.

Then the rotor after receiving an impulse goes back to its normal position and exceeds it, assuming a pendular motion. This motion would be kept up indefinitely if there were no damping actions. Regarding the frequency of oscillations, Blondel gives for it the following formula:

$$F = \frac{p}{2\pi}\sqrt{\frac{2\,E_1\,E_2 \sin\left(a\,r\cot\frac{2\,\pi\,L}{r}\right)\cos\theta}{2\,\pi\,n\,R\,\sqrt{2\,\pi\,n\,L^2 + r^2}}}$$

Where $2p$ is the number of poles, n the frequency of the current, K the momentum of the rotating part. A similar formula is given by Steinmetz.

The influence which the formula attributes to the resistance and reactance are stated to correspond exactly to the results of the tests made by Mr. Semenza.

Owing to friction, a pendulum does not maintain its motion indefinitely; analogously, the currents produced by the pendular motion of the alternator in all the metallic parts of the machine and the mechanical friction absorb the energy of the oscillations. Therefore, it must be borne in mind that the pendular motion cannot be kept up by simple inertia on account of the strong damping forces, but there is necessary the intervention of another cause to continue the vibrations.

In the experiments related above it was noticed that the pendular motion started with no apparent external reason, and that the vibrations increased in amplitude gradually up to a certain limit. The test of the first series shows that the cause of the phenomenon is to be found in the motor itself. This cause, which has been pointed out recently by Steinmetz, is the reaction of the armature. When the current of the armature is in phase with the e.m.f. of the alternator, it sets up a flux of reaction, the effect of which is comparatively small, due to the fact that when the polar shoes are exactly in front of the coils of the armature the current in these coils is zero. It is known how the reaction increases when the current is lagging or leading. Now, when the motor or the alternator is oscillating, the reaction of the armature will pulsate with the same frequency, the displacement of phase of the currents being variable during the oscillation. But since the flux in the iron is not in step with the m.m.f., but is lagging behind it on account of the molecular friction of the iron, the reaction of the armature will attain its maximum value while the poles are coming back after having made their maximum swing.

If we suppose that the swinging has originated a leading current, the reaction will help the flux of the inductor; and when the poles start backward from the farthest point of the oscillation, the inducing flux will keep on increasing for a little while, thus giving to the rotor an impulse in the same direction in which it is itself changing its speed. A similar result would occur in the case of a pendulum if the soliciting force were increased in the descending period and decreased in the ascending period, in which case the amplitude of the oscillations would tend to increase.

We have then two forces which act oppositely—the impulses due to the reaction of the armature tending to amplify the oscillations, and the damping forces tending to stop them. The phenomenon will naturally assume different forms, depending on the value of the above actions.

When the alternator running in parallel or the synchronous motor is in the condition of minimum current, the difference of phase is very small and the reaction consequently weak; the damping forces overrule and there is no pendular motion.

On the other hand, when the machines are working in the higher part of the V curve, the currents are heavy and considerably out of phase; consequently the intense reaction varies very much in accordance with the pendular displacement, and there will be a tendency to originate a permanent oscillatory motion of such amplitude that the energy of the soliciting impulses is equal to the energy absorbed by the damping forces. If the special conditions of the circuit call for amplitudes exceeding the limit angle of stable running, the machine will fall out of step; under other conditions we will have stable operation or the permanent pendular motion.

Signor Semenza shows how the results of the tests mentioned in the first part of his paper and the other experiments related by Signor Rebora may be easily explained by the above theory on the running in parallel of alternators. He finally puts forward the following general ideas on the phenomenon.

In every case of running in parallel any perturbation in the speed has a tendency to produce the pendular motion. The oscillations are favored and supplied by the pulsations of the reaction of the armature, which pulsations on account of the magnetic hysteresis of the iron act to encourage, while the damping forces which absorb the energy of the oscillations tend to stop forced pulsations.

Every action increasing the reaction of the armature helps to produce the oscillations. The resistance and the reactance of the circuit have a very important effect, and the resistance may cause some serious troubles when the two synchronous machines are connected through a long line. In fact, the resistance of the alternator is generally very low in comparison with its reactance; by introducing in circuit a line with a resistance of the same order of magnitude or even much higher than the reactance, the ratio between these two quantities may fall beyond the limit of regular operation.

These limits depend on the construction of the alternator, and generally in the case of a long line of transmission they are easily reached.

The operation in parallel of power houses situated far apart can no longer be considered as a problem of easy solution, and manufacturers will be required to design special machines to fit particular cases.

Signor Semenza, in conclusion, expressed the hope that a complete theory of the phenomena considered may soon be contributed by an authority in the branch of alternating currents.

Variation of Motor Speed With Variable Line Voltage.

BY J. L. DICKSON.

THE question of variation of motor speed with line voltage is an important one, and it is the purpose of this article to outline in as simple a manner as possible two different methods of investigation.

In Fig. 1 let M represent the armature of a shunt motor, F its field, R the field resistance, S a switch for breaking the circuit, T the mains, and L a lamp bank. The apparatus is to be connected

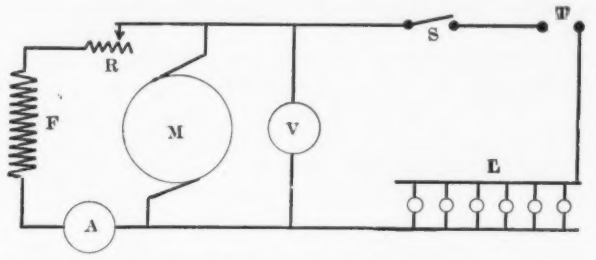


FIG. 1.—CONNECTIONS FOR VARYING CURRENT IN FIELD, VOLTAGE AND SPEED.

up as shown in the diagram, the voltmeter, V, being across the brushes of the machine and the ammeter, A, in the field circuit. The object of the above connections is to vary the current in the field, the voltage across the brushes and the speed of the armature. This is accomplished by means of the lamp bank, L, which regulates the amount of current passing through the entire circuit.

A definite amount of current is allowed to pass through the lamp bank, then the armature is brought up to normal speed by regulating the field resistance, R; the current through the lamp bank is then gradually decreased, step by step, until a sufficiently low reading is obtained, the speed and voltage in each case being noted.

Let us assume that during a certain test readings in Table I were taken:

TABLE I.

Volts Across Brushes.	Armature Speed r.p.m.	Field Amperes.
114	780	1.71
101	720	1.53
96	695	1.45
89	667	1.33
82	640	1.22
66	600	.98
62	585	.92
58	578	.87
55	570	.83
54	566	.80
52	564	.77
49	560	.72
46	558	.68
43	546	.64
36	533	.54
32	520	.47

From these data let us plot the volt-ampere curve (Fig. 2), using volts across brushes as abscissæ and field amperes as ordinates. This curve is found to be a straight line and shows that the voltage across the brushes varies directly with the field amperes.

The above curve can also be obtained as follows: It is seen from Table I that the drop in voltage is 114-32 or 82 volts, and the re-

sistance for the first reading is $R = \frac{E}{I} = \frac{114}{1.71} = 66$ ohms, while

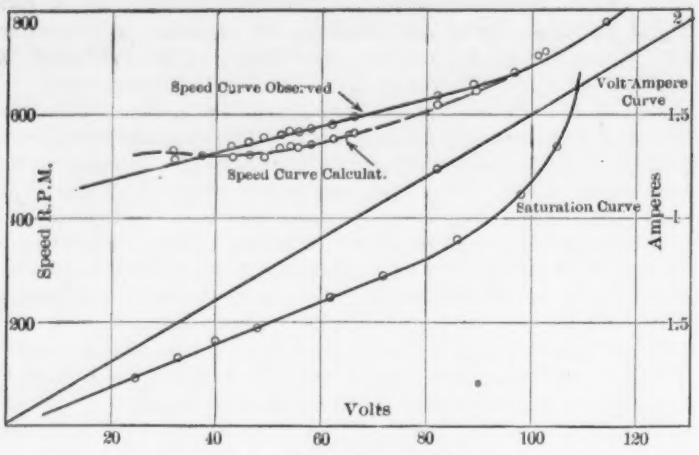


FIG. 2.—VARIATION CURVES.

for the second reading it is $R = \frac{101}{1.53} = 66$ ohms. In this manner it is found that the average resistance is 66 ohms; therefore, the current is $I = \frac{E}{R} = \frac{82}{66} = 1.24$ amp. We then plot 1.24 amp. and 82 volts and connect this point with the origin by a straight line.

Also, from the above readings a speed curve is plotted, using volts across brushes as abscissæ and armature speed as ordinates. This curve shows that these two quantities bear a certain relation to each other, and that as the voltage increases so does the speed, but more gradually and not in a like proportion.

The motor is then to be used as a generator and connected up for a saturation test as shown in Fig. 3, where G represents the armature, F the field, R the field resistance, S a switch for breaking the circuit, L a lamp bank and T the terminals of the generator, G. The

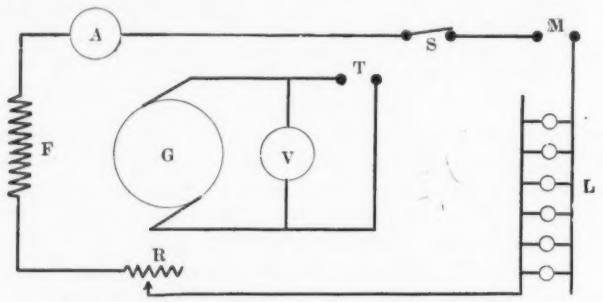


FIG. 3.—CONNECTIONS FOR SATURATION TEST.

field, F, is separately excited from the mains, M, and an ammeter, A, is placed in the circuit as shown. The machine is brought up to speed and the field, F, excited from the mains, M; then the current in the field as read by the ammeter, A, and the voltage across the brushes, taken from the voltmeter, V, are to be noted; the current in the field is then decreased by adjusting the lamp bank and the voltage and amperes again noted. The current is thus decreased until the desired amount is obtained, readings being taken in each case. Suppose for this test the following readings in Table II were noted:

TABLE 2.

Volts Across Brushes.	Armature Speed r.p.m.	Field Amperes.
105	780	1.36
98	780	1.13
86	780	.89
72	780	.72
62	780	.62
48	780	.46
40	780	.36
33	780	.31
25	780	.23

From these readings a saturation curve is plotted (Fig. 2) using volts across brushes as abscissæ and current in field as ordinates. This curve shows that the voltage increases with the current, but not in the same ratio.

If it is desired to obtain the speed curve by calculation, from Table I it is seen that the speed varies with the voltage in the armature, or $S = V_A$ (1) where S = speed in r.p.m. and V_A = volts across armature. Also, the speed varies inversely with the magnetic field, or letting the field be represented in volts generated at speeds 780, 720, etc. (Table I) we have

$$S = \frac{1}{Fv} \qquad (2)$$

where Fv = strength of magnetic field in volts.

Equation (1) is then combined with equation (2) and there results:

$$S = \frac{V_A}{Fv} \qquad (3)$$

The speed for each reading equals $\frac{V_A}{Fv}$ multiplied by some constant, K, or

$$S = K \times \frac{V_A}{Fv} \qquad (4)$$

Substituting the first values from Table I we have $780 = K \times \frac{114}{114}$, or solving the above equation, $K = 780$. Therefore, the constant is found to be 780. (Fv is taken as 114, because for this reading the strength of magnetic field represented in volts is 114.)

The second values, Table I, are then substituted in formula (4), or

$$S = 780 \times \frac{101}{108} \quad \text{or}$$

$$S = 729 \text{ r.p.m.}$$

The magnetic field, $Fv = 108$, is found from the volt-ampere and saturation curves (Fig. 2). We find 101 volts on the volt-ampere curve, and from this point we go horizontally across to the saturation curve and from this last point we come vertically downward until the abscissæ axis is reached; here the voltage is read and for this case it is found to be 108 volts.

The above method is pursued for finding the magnetic field, Fv, for each case, and substituting in the speed formula we have the values given in Table III:

TABLE 3.

Volts Across Brushes.	Armature Speed r.p.m.
114	780
101	729
96	699
89	664
82	627
66	562
62	550
58	538
55	530
54	533
52	534
49	531
46	533
43	524
36	530
32	531

From these readings another speed curve is plotted as before, which is shown in broken line in Fig. 2, and resembles very closely the previously plotted speed curve. If counter e.m.f. and slight inaccuracy in plotting and reading curves are considered, it is very probable that this latter curve would correspond nearly exactly with the observed one.

The Telescriptograph.

The following rather curious item comes to a New York daily newspaper in a cable dispatch from Brussels of June 11: "M. Malcotti, an Italian engineer resident of this city, has invented an instrument which he calls a telescriptograph, and which will reproduce in print all conversations held over the telephone. He has already secured patents in several European countries and in the United States, where he intends to install his service with the aid of some telephone company. Experiments given in public have demonstrated the wonderful achievements of the young inventor, who claims that his instruments will work without extra wires and apparatus over any ordinary telephone line."

Storage Battery Plate Construction.

BY S. H. RABENALT.

WITH reference to the article written in the ELECTRICAL WORLD AND ENGINEER under date of May 21st, by Mr. W. W. Donaldson, on "Storage Battery Plate Construction, with Special Reference to Discharge Characteristics," I take the liberty to take exception to a few statements made.

1. " * * * Provide for good electrical conditions, and the mechanical will take care of themselves." This is hardly a right fundamental principle for the construction of a Planté plate. Is it not just as important that a battery plate retain its original shape, its mechanical structure, during its working period, as it should fill the other requirements of capacity, low-potential drop on high rate discharges, low internal resistance, etc.? Not only should this point not be neglected, but it should be one of the fundamental points to be considered in the construction of Planté, or, in fact, any plates.

One of the chief requirements in station batteries is that the possibilities of short-circuits be eliminated as far as possible. Of necessity, therefore, the plates proper must be rigid; that is, their shape and mechanical structure should not change during the entire life of the battery, no matter what changes in form the active material portions are undergoing.

Most of the Planté designs of the present days comprise ribs and grooves, varying in shape and size, the grooves being designed to hold the active material—electrochemically formed from a part of the ribs. Now, if the plate is to maintain its capacity, the active mass must be retained in the grooves. Experience has taught that the best method of accomplishing this most efficiently is to fill the grooves in the forming process rather tightly, thus not allowing the active mass to become separated from the contact surface by violent gasing resulting from excessive overcharges, which Planté plates are expected to withstand; but where a space is left in the grooves between the layers of active mass on each side, this does occur, and the result is evident.

It is a common thing for Planté positive to "grow" and "buckle," both being most frequently caused by excessive overdischarging and not sufficient charging; this causes an additional formation and volume increase of the active material, this being called "Planté action." The grooves—assumed filled—are unable to accommodate this addition of mass, and the whole active portion (the portion of the grid which contains ribs and grooves) expands. If the expansion on both sides of the plate is balanced, the plate "grows" (expanding force acting in a linear direction); if unbalanced, the plate "buckles" (expanding force changing its direction continually). It is the "buckling" that causes the numerous short-circuits in some types of batteries.

On the other hand, if the grooves are not quite filled with active mass, thus providing space for the "Planté action," the possibilities of growing and buckling are very much decreased, but how about the capacity question? Before benefit is derived from this provision of space, the amount of the active mass may have been reduced considerably, as mentioned above, and the provision prove useless.

It would, therefore, seem advisable to construct a Planté positive of a large number of small "units," comprising the "active portion" of the plate, and to weld these into a solid and rigid frame of antimonial lead. (I do not belong to the class of "cranks" who believe in "always complicating and retarding the proper chemical actions. * * * ") Each section or unit should be joined to the frame at its upper edge only, and be allowed to follow its tendencies, to expand or grow, in three directions, and there should be sufficient space provided that these changes in the individual units may take place without destroying or changing the form or dimensions of the plate as a whole, which fact allows the individual units to be constructed so as to retain the active material.

The writer, who is fortunate in having had an appreciable amount of practical battery experience, considers this type of a Planté positive more nearly the ideal station plate than that described by Mr. Donaldson, in spite of the fact that he condemns the class of "built-up" plates most decidedly. The fact that there are Planté positives in service, whose vertical edges follow a zig-zag line after several months' use, and the shape of the active portions reminds one of a bowl, shows conclusively that there are constructors who "let the mechanical conditions take care of themselves!"

2. "The fundamental requirements for both plates is that their active material must be formed by an electrochemical action. No paste or applied active material should enter into the construction of either plate for stationary high-discharge work." Why? The necessity for a Planté positive, of course, is evident, and the subject has been so thoroughly and on numerous occasions, dealt with, that I consider it superfluous to go into details. But how about the negative?

As far as the writer is aware, there is but one storage battery company in the world that installs batteries having negative plates of the Planté type, and as the number of installations of this kind probably amounts to no more than 1/100 of one per cent. of the total battery installations, it is unreasonable to assume that the use of a Planté negative plate is ideal or even desirable.

The assertion above noted is too general for a detailed discussion. It might be mentioned, however, that batteries installed with Planté negatives, result in exceptionally high c.e.m.f. on charge, and are very susceptible to "treeing."

3. " * * * The plate must not be built up of separate parts." This is another statement to which I take exception. Mr. Donaldson goes on to say that the active material should not be relied on as a conductor of current. Here it seems to me that the author has in mind a certain type of an earlier origin than "the well-known type" whose positive plate is mainly characterized by the peculiarly shaped active units which suggest a series of buttons. In that type it is true the entire current, developed in a unit or button has to travel through a portion of the active material (the periphery of this spiral), the active material being compelled to take the part of a conductor. I admit that in this respect the mentioned type does not comprise the "ideal" Planté plate, but undoubtedly the type in question results in a rigidity which cannot even be dreamed of in connection with the "well-known type."

It is not necessary that the active material of a small unit should play the part of conductor, as it does not in the type described by the writer. Therefore, it is not fair, from a neutral, technical point of view (which I suppose the author has taken), to condemn a class of plate generally because he finds a bad defect in one particular type of this class.

4. It is stated that no other metal save pure lead should be used. There is certainly constant local action between the PbO_2 and Pb of the grid, this being an increased function of the contact area, but in my opinion the increase in local action caused by a moderate percentage of antimony in the grid (the only metal alloyed with lead for battery use) is, if other conditions are kept the same, inappreciable.

5. I will, of course, not deny the fact that rolled lead is denser than cast lead, and I also admit that the former offers somewhat more resistance to the oxidizing actions of the current, i. e., Planté action. But to generalize the claim of superiority of one kind of lead over another on that score is not justifiable. And contrary to this assertion, I wish to say that in some respects it may not be best to employ rolled lead in battery constructions, for the plates will very frequently be subjected to excessive overcharges, more seldom overdischarges. This condition will develop a very pronounced tendency, caused by violent gasing, to expel the active mass, emptying the grid and decreasing the capacity in proportion. If very dense rolled lead has been employed in the construction, the contact surface will be very smooth; and owing to the greater resisting qualities toward Planté action, will remain smooth, with an extremely thin layer of peroxide and a proportional capacity. Cast lead being more susceptible to Planté actions, will be peroxidized by the repeated charges and discharges to a far greater extent, giving to the positive plates the ability to take and hold a charge, while plates of rolled, dense lead will be less attacked and will have proportionately less capacity.

In cases where batteries are subjected to very extensive discharges, especially at low rates, and also charged at quite low rates, it would be best to use a very dense lead. The density of cast lead may be greatly varied by varying the pressure under which the casting is done, or by compressing the casting as it solidifies.

6. Some interesting figures are given for percentages of weight of supporting frame to weight of plate proper. As to 15 per cent. for frame construction, it is obvious that "the mechanical conditions take care of themselves." If a plate is to remain in its original shape and not adopt curves similar to an ocean wave, it might be well, perhaps, to increase the above percentage.

It is impossible to give an absolute figure for the amount of lead

to be used in the frame construction, as it depends entirely upon the design of the grid. While in some well-constructed types 25 per cent. to 30 per cent. may result in a rigid plate, 40 per cent. to 50 per cent. may prove insufficient in some others, and the "well-known type" has proven conclusively that 15 per cent. is altogether insufficient.

The contact area and thickness of the support (ribs) are, in my estimation, well considered.

7. It is stated that the plate, as a whole, should be as thin as consistent, and should not exceed one-half an inch from face to face. The object of this is not clear to me. It would be very interesting to hear on what basis this assertion is made.

For each individual type such limit can be determined, beyond which the characteristics are commenced to be unfavorably influenced, but hardly for *all* types. I wish to mention the fact that some leading European types exceed a half inch by a good deal. Were those constructors all wrong in their viewpoints?

8. The argument is advanced that the grooves should be tightly filled in order to maintain contact between the grid and the active mass. This argument I condemn most decidedly. The fact that a groove is tightly filled will not prevent the formation of additional peroxide if conditions favor a tendency for it.

If the grooves are so tightly filled that they are unable to accommodate additional mass, the mass will make itself the necessary space. If the frame construction (which encloses the active portions *tight*, not providing for expansion space) is made out of soft lead, the plate will grow and buckle. If the frame construction is made out of antimonial lead (with a comparatively high percentage of antimony) the plate will very often crack and break.

It is further stated that the negative plate should be integral and of pure lead, alloys to be avoided on account of local action. If local discharges take place in negatives, it is not so much due to the action of alloys, as due to a primary sulphation of the spongy lead. Metallic lead undergoes a slight sulphation in diluted sulphuric acid. Since from a chemical point of view spongy lead and solid lead are one and the same (the difference between the two is solely of physical nature) the spongy lead will, therefore, also undergo a sulphation, only to a much greater extent, for the spongy lead offers the acid more attacking area, being so finely divided. And sulphation of an active mass means discharge.

It is claimed that "local actions due to alloys are the chief cause of capacity loss in many forms of negatives." There is, of course, local action between an alloy of lead and pure lead. But is the local action in a positive not far greater? First, the contact area in a positive is from 10 to 20 times as large as the area in a negative, and the local action takes place in a ratio to the contact area. Second, the intensity of the current being active in the local discharge is far greater between peroxide of lead and lead as between a lead alloy and pure lead, because the former combination gives a much higher e.m.f. than the latter.

The maximum local discharges in a negative (the primary sulphation plus the electrolytic sulphation caused by the alloy) are only a very small portion of the local discharges which take place in the positive plate; therefore, this point can be neglected with good conscience.

Central Station Office Methods and Accounting.

In introducing his paper on the above subject read before the recent Boston Convention of the National Electric Light Association, Mr. Frank W. Frueauff said that the lighting companies throughout the country are all making an effort to increase their sales of current either to present users or new consumers, or by taking on business that was formerly done by isolated plants or other forms of power. These conditions have necessitated a much closer study of costs and receipts and have resulted in a much finer separation of the items entering into the cost of production for any particular class of current or for consumers using service in an unusual way. The usual method of grouping all expenses under the three arbitrary heads of manufacturing, distribution and general expenses and making separation under them for different sub-divisions desired, has only given costs and must therefore be misleading for purposes of figuring for new business to be secured or for analyzing present results in order to know the profitable from the unprofitable business. The plan of apportioning the costs of operation to the class of current made and of separating fixed and variable costs has therefore come to be a necessary part of a company's report of operations, and is now in operation among a number of companies with marked success.

The expenses occasioned in manufacturing and distribution for any one class of current are kept distinct from those incurred in another, so that the actual cost of manufacturing and delivering arc, power or alternating current is known separately. These costs for any one class are also separated to show the costs that are fixed as distinct from those that are variable. For example, station foreman, meter department, shop expenses, etc., are practically a fixed expense; that is, they are an expense resulting from the size and running of an electric business and do not noticeably vary as the business may increase or decrease. Some expenses depend upon the amount of current made and sold; that is, they vary with the output. For example, boiler fuel, firemen, lamp renewals, carbons, and so on. A third class of expenses is made up of those that vary with the number of consumers supplied or number of meters in use. Under this head may be included meter repairs, arc-lamp repairs, service repairs, meter-reading expense, collection and office salaries.

With the cost of current for any class of current separated into these three divisions, it is possible to know just what results are being obtained. One may then know whether or not the output expenses are increasing at a greater rate than the output, and if the expenses proportioned to consumer are increasing faster than the number of consumers. In figuring rates to be made to secure new business this plan of separating costs is particularly valuable. For example, in figuring to take on a long-hour burning consumer you know from the figures of costs that the fixed costs will not be materially increased, nor will the consumer expenses, and that only the output cost will be increased. You may therefore assume that this business can be secured at a very low figure and still show a much larger margin of profit than business that will add to your expenses of capacity or consumers while only showing a small amount of current used.

COMPLAINTS.

The electric companies are now realizing as never before that a satisfied consumer is one of their best assets. To make or hold these satisfied consumers requires constant and careful watching. A department of the business is established where these complaints are received and adjusted. They must be systematically followed up or great dissatisfaction will result. One plan in use is to record all complaints as received, showing the date, name, address, time complaint was received and nature of complaint. From this record typewritten orders in duplicate are made on a 3 x 5 slip, the original being sent to the inspection department immediately and the duplicate being held to insure the return of the original. The order is given to an inspector, who attends to the complaint as carefully as possible. He notes on the order the result of his investigation and signs it, when it is returned to the order or complaint department. The date of execution and name of man are entered on the record and the duplicate taken from the pack of outstanding orders. A reply postal card is then made out from the order, stating that complaint had been made of certain trouble and asking if our inspector had attended to it satisfactorily, these cards being sent in answer to all complaints. The reply cards do not all come back, but we are sure that if the investigation or work has not been satisfactory consumer will be sure to reply. If an unfavorable reply is received, an order is sent to inspection department calling attention to unfavorable report, and when work is again completed another reply card is sent. The original order is then sent to the filing room, where all orders of every class are filed by dates under the street number, this file being used for reference from time to time and giving a complete history of all work done by the company at any house connected to our system.

A daily report is made from the order record, showing the number of complaints received, separated by classes, and showing the number of each class for same days of previous year and the accumulative number received during the past month. This report is sent to the general manager each day and enables him to keep in touch with the troubles coming up. At the close of each month a statement is prepared showing the number of complaints handled by each inspector and the number from which "unsatisfactory" reports were received on the reply cards, also showing the per cent. of satisfactory work done. This report, after being inspected and signed by

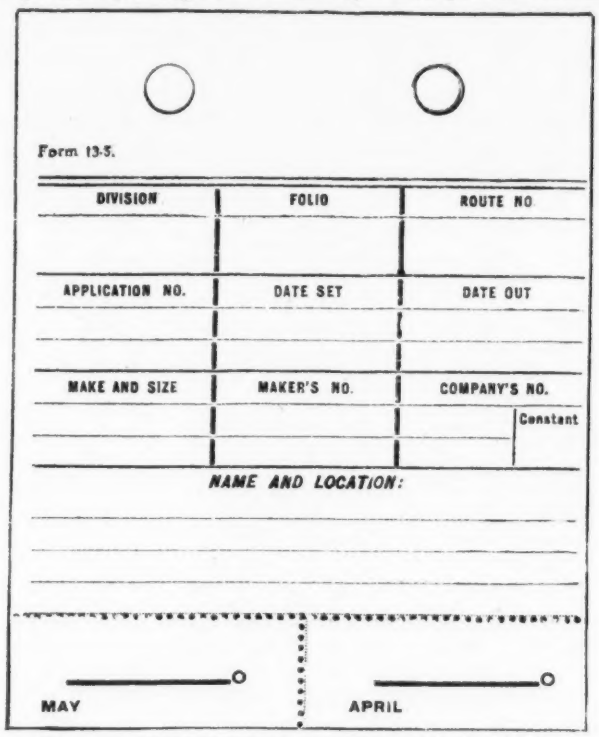
the general manager, is posted in the inspection department where all men can see it. This plan of compiling the efficiency of the men has a splendid effect in stimulating them to careful and thorough work on all orders, and means a saving of time and money to the company and better feeling on the part of the public.

BUREAU OF INFORMATION.

A new departure in the office is the establishment of a "bureau of information." This bureau is located in the most conspicuous point in the office and is in charge of a clerk thoroughly posted on all general matters of the company. His duties are to direct any and all inquirers to their desired point, such as application window, teller's window, manager's office, appliance department, etc. He has charge of the list of desirable vacant houses in the city, and upon request directs the inquirer to the real estate agent who has the property in charge. This list of houses includes only those along the company's lines or mains and only those that are equipped to use the company's service. By this plan we are able to get newcomers to the city, or those intending to move, to occupy houses where we can supply them without further investment. The list is revised each day by reports made from the soliciting and application departments of houses connected and disconnected. In connection with the bureau of information, bulletin boards have been placed at each plant, shop and department of the company. Upon these boards any announcements of changes of regulations, special inducements, information of particular importance to employees and copies of all new advertising matter being sent out are posted, in order that the employees in every branch of the business may be kept in touch with what is going on, and may be in position to talk intelligently if questioned when attending to their duties, or after hours.

METER READING.

One of the most important requirements for satisfactory relations with consumers is the necessity for accurate meter reading and billing. The coupon system of meter reading cards, originated by Mr. S. J. Glass (see Fig. 1, in which only the coupons for two months


Form 13-5.

DIVISION	FOLIO	ROUTE NO.
APPLICATION NO.	DATE SET	DATE OUT
MAKE AND SIZE	MAKER'S NO.	COMPANY'S NO.
		Constant

NAME AND LOCATION:

MAY APRIL

FIG. 1.—COUPON SYSTEM OF METER READING CARDS.

are shown), seems to be the best and safest method in use. Under his plan a slip with 12 coupons attached is made for each meter; each coupon bears an identifying number, corresponding with the account on the consumer's ledger. After the meter has been read and bill made the coupon is detached and filed for reference. The meter reader then has only the meter number and house number to direct him when he next takes the reading. By this plan no readings can be averaged or readings put down without actually seeing the meter, and as the man has no previous reading to assist him, he must use unusual care to get the correct figures.

By keeping the same men reading each month and throughout the month and not picking up extra men each month to take statements, a considerable saving can be made, as men familiar with the routes can make much faster time and will not have to go back to get meters skipped or read wrong on the first trip. The plan of posting a list of all mistakes made by the meter readers will also increase the efficiency of this department. At the close of each month a list is posted in the department showing the number of meters read by each man and the number of errors discovered. A bonus is paid to each man who makes no mistakes during the month. One month's records show 13 men read 32,000 meters with a total of but eight errors made by all these men.

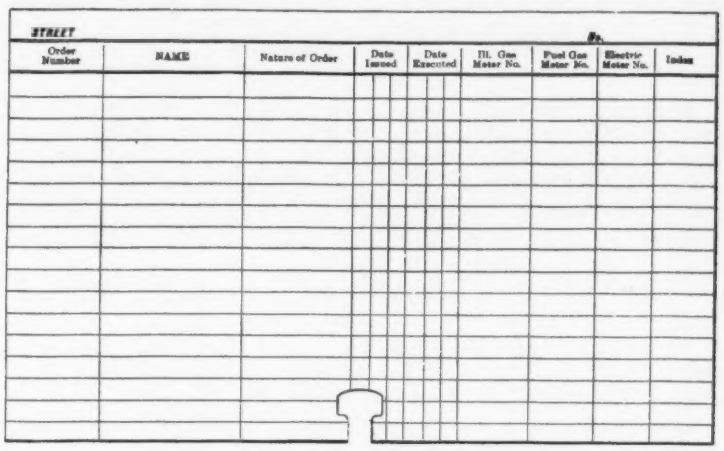
OFFICE MISTAKES.

The plan of recording and then posting a list of all errors made by the consumers' bookkeepers is followed. In this list appear any errors or omissions made by them, including errors in extensions and calculations, failure to send bill to proper address, omission of balance owed for previous period, and so forth. This posted list has the same stimulating effect as the lists of errors made by the meter readers and trouble-men.

In the general office a Dey registering time clock is used. All office employees are required to register as they come into and leave the office. From this record the office time is kept. We find it of particular value in impressing promptness upon all employees; and as clerks are on duty from seven a. m. to midnight, it is possible to know the time they arrive and leave without requiring the chief clerk or a time-keeper to note their movements. A list is posted each morning of any who have registered late in arriving or who have overstayed the hour off for lunch. At the close of each month a list is made of those who have been prompt and punctual throughout the month.

CARD RECORDS.

The use of card index records in offices is constantly growing and is satisfactory for most purposes. We are now using a house record (see Fig. 2) index in our application and order department.


STREET No.

Order Number	NAME	Nature of Order	Date Issued	Date Executed	Ill. Gas Meter No.	Fuel Gas Meter No.	Electric Meter No.	Index

FIG. 2.—HOUSE RECORD.

A card was made for each house connected, and as orders were taken to connect, disconnect, or change meter, arc lamp, etc., a posting to this effect was made on the house card; after the order had been executed the date of execution was entered on the card, so that we constantly have a record of our standing at each house. This has done away with all duplicate or wrong orders. Under the old plan of listing orders in a book or books we frequently sent men to re-read meters for a new tenant when we had just ordered the meter returned on instructions from the old occupant; but with the house card to refer to before sending order to shop for execution, a wrong order is detected and new one substituted to cover the latest development, or the order previously sent out is ordered recalled.

Visible-writing typewriters with card-holder attachments are used on all orders of every description. We find by their use fewer errors in copying and reading addresses and that names of consumers, being more legible than when written by hand, are correctly carried through the records and to the addressing machine.

The filing cabinet referred to before is also a feature in the card system. A guide card is placed for each street and number, and back of it are filed all completed orders for setting or removing of meters, complaints, connection of appliances, etc. If it is desired to refer to any original order, it is readily located by this plan.

For the record of stock of materials carried, a loose-leaf system is in use. One sheet is arranged for each article, showing amount on hand and received in one column, the amounts sent out in another, and a column to show the running balance of materials on hand.

This record is kept to show both the quantity and value of each article in stock, and is kept up each day from the storekeeper's reports of materials received and sent out.

ACCUMULATED REPORTS.

After the monthly report is complete, the records therein shown are transferred to loose-leaf sheets containing columns for every item on the report; these figures are carried on an accumulative basis and always show the results for the past twelve months, this being done by adding or deducting the difference between the last month and the corresponding month last year, from the previous yearly total. These accumulative figures show much more clearly any real increase or decrease, and are not misleading, as the results for any one month might be. From these accumulative sheets a year's report can be made without any trouble or delay.

OFFICE LABOR-SAVING DEVICES.

In Mr. Anthony's paper, read before the convention last year, he described several of the labor-saving methods in general use. I will therefore refer only to some not mentioned by him.

We use a Boettescher & Knecht machine in the teller's cage for receipting all bills. This machine is driven by an electric motor. The bill is placed in front of the machine by the teller, who then touches a spring; this releases the lock and sets the machine in motion, the bill is drawn under the roller, the coupon cut off and dated and dropped in a drawer below and the receipted bill forced out to the front of the window, where it may be picked up by the consumer.

We are now using an adding machine made by the Universal Adding Machine Company, of St. Louis, which has an electric driving attachment. Instead of pulling down a lever, as with the usual adding machine, a spring is touched which sets the machine in motion and performs the same office as the lever.

Self-adding sheets are a simple arrangement used in tabulating results such as number of meters or consumers gained or lost, and so forth. The sheets are ruled for units and every tenth space is so marked. When all marks are down the number of vertical spaces times the number of horizontal spaces used shows the total desired.

The slide rule frequently used in engineering work can be made to play an important part in modern office methods. Clerks can be easily instructed in its use and calculations requiring multiplication or division worked out in much less time than by the old methods.

The Thatcher calculator made by the Keuffel & Esser Co., New York, we have found the greatest labor saver yet tried. All costs and receipts are worked out on the reports on a basis of current made or sold. With several hundred separations, it will require a couple of days' time to do the division required. By the use of the calculator the results may be set down as fast as one can read the numbers on the machine. This machine is unique in construction and easily understood. Where a constant multiplier or divisor is used the results are shown more quickly than with any of the other calculating machines. This feature therefore makes it particularly valuable in use on monthly reports.

A tube system, such as is used in department stores, has been of great benefit to us. We have connection at all windows in the accounting office direct with the bookkeeping and collection rooms. If a copy of a bill is desired or explanation required, the detail can be secured in much less time than by going to consult the books and leaving the consumer waiting. We are able to do all bookkeeping work on another floor of the building, which is away from all the disturbance of the public office. We find that by this plan our bookkeepers are able to handle more accounts and with fewer interruptions.

We are installing a Hollreith electric tabulating machine. This machine is now in successful operation in a number of railway accounting offices, in some large factories, and was used by the United States Census Bureau in compiling its statistics. The equipment consists of two parts: The punch, into which properly printed cards are set, transfers the information by punching a hole in the proper space. When all information has been transferred to the punched cards they are set in the tabulating machine, which sorts them into several kinds and then compiles the information. It is our intention to use this machine to tabulate our records of all consumers, to show the possibilities of each class of business, and to use it in making up the pay-rolls. Use will also be made of it in our engineering department in keeping track of our current made, sold and lost, of the various types and efficiencies of transformers and meters.

Your reporter received his appointment at such a late date as to prevent his making inquiries among the different members as to their experience with any new office methods or labor-saving devices. I have therefore only mentioned some of the methods now employed in the Denver office. We have endeavored to kep in touch with all the newer plans suggested for accounting and for labor saving, and have adopted any that seemed to have advantages over those previously employed.

STEAM GENERATION.

An analysis of steam generation enables us to determine what proportion of the generating expense should be charged to each class of current sent out from the station. The generating apparatus for the different kinds of service is usually not of the same efficiency. To compensate for this we apply the average efficiency of the apparatus to the output in kw-hours of each class of current. This gives us at the throttle valve of the engine the equivalent of the output from each class of current. From this point the generating expenses proportional to output are common. Having this equivalent steam energy, we can divide the generating expense in the same proportion that this equivalent energy appears. This would give us expense proportional to output, which should be charged to each class of service. The expenses proportional to capacity should be divided in proportion to the capacity of each class of apparatus in the station.

Test of Westinghouse-Parsons 400 KW Steam Turbine.

In December last Messrs. Dean and Main, of Boston, made an elaborate test of a 400 kw steam turbine at the works of the Westinghouse Machine Company, East Pittsburg, Pa. As is well known, these works are provided with all facilities for the most accurate steam consumption tests of engines of the largest size. In making the present tests the condensed water was measured at intervals of ten minutes and the brake horse power was determined by means of a water dynamometer of the Froude type. The duration of the tests was two hours for the full load test with 100° superheat, and one hour for most of the other tests, though a few were made 20 to 30 minutes in length. The accompanying table gives the results of the principal test.

TEST OF 400-KW STEAM TURBINE.

Dry Saturated Steam.	Overload.	Full load.	Med'm load.	Low load.
Revolutions per minute	3,481	3,545	3,583	3,602
Throttle gauge pressure	153	154	156	156
Vacuum	26.87	26.84	26.80	26.90
Ratio of rated load	1.26	1.02	0.77	0.42
Steam per brake hp-hour	13.63	13.91	14.48	16.06
Superheat, 100° F.				
Revolutions per minute	3,457	3,546	3,580	3,588
Throttle gauge pressure	150	156	154	153
Vacuum	27.10	27.06	27.10	27.10
Ratio of rated load	1.31	1.02	0.77	0.41
Steam per brake hp-hour	12.07	12.41	12.86	14.62
Superheat, 180°.				
Revolutions per minute	3,477	3,542	.....	.....
Throttle gauge pressure	151	154	.....	.....
Vacuum	27	27.10	.....	.....
Ratio of rated load	1.32	1.02	.....	.....
Steam per brake hp-hour	11.17	11.45	.....	.....

Tests were also made to determine the variation of the speed of the turbine at different loads. This variation in the test with steam superheated to 100° F. was 2.5 per cent. below speed at rated load, for 31 per cent. overload, the figures for 77 per cent. load and 41 per cent. load being .9 and 1.2 per cent. below rated speed, respectively. In the test with dry steam the variations were 1.8 below normal for 20 per cent. overload; 1.60 per cent. above for 42 per cent. load, and 3.4 per cent. above for friction load.

The report contains curves showing the effect on economy from superheat, which indicate that the saving is 1 per cent. for every 10° of superheat between the limits employed in the tests.

The report calculates the thermal efficiency of the turbine tested for the several different conditions of operation. Since the thermal efficiency of a reciprocating steam engine is usually referred to indicated horse power, and as the tests of the turbine were in terms of brake horse power, in order to have a common basis for comparison it was assumed that the friction of a reciprocating engine is 6 per cent. On this basis of internal steam horse power, the thermal efficiency for dry steam is given as 17.22 per cent.; for 100° superheat 18.43 per cent., and for 180° superheat, 19.43 per cent.

Recent Electrochemical Developments.

INDUCTION FURNACE.

In the metallurgy of iron and steel electric furnace methods have been commercially successful up to the present mainly along two lines, the production of ferro-alloys and the manufacture of special high-priced steels. The high temperature easily attainable in the electric furnace is of decisive importance for the production of certain ferro-alloys, on account of the high reduction temperatures of the oxides treated. On the other hand, for the production of special steels (which have to compete with our crucible steels) no specially high temperature is required, since the process is essentially a smelting operation, and in this case the cleanliness and easy control of the electric furnace operation, the impossibility of impurities being introduced into the charge from the fuel or fuel gases (because there are none) and the ease of treating any large quantity of charge in a single operation are of signal importance. The only difficulty to be solved in this case is the prevention of impurities being introduced into the charge from the electrodes, as we generally say, although the term is improper, since no electrolytic action takes place; the "electrodes" are here nothing but terminals by which the electric current is introduced into the charge from the external source of current.

The most radical course of solving this difficulty is to use no electrodes or terminals whatever, but to introduce the electric current into the charge by inductive action in the same way as electrical energy is transported from the primary of a transformer to its secondary. In fact, the induction furnace, as operated by Kjellin, at Gysinge, in Sweden, for the production of special steels, is essentially a transformer; its primary winding, having a large number of turns, is supplied with high-tension alternating current, while the secondary has a single turn and is constituted by the charge to be melted. However, the furnace design of Kjellin seems to be capable of improvement. The efficiency of his furnace is rather low. According to *Electrochemical Industry* (December, 1903, page 578) the

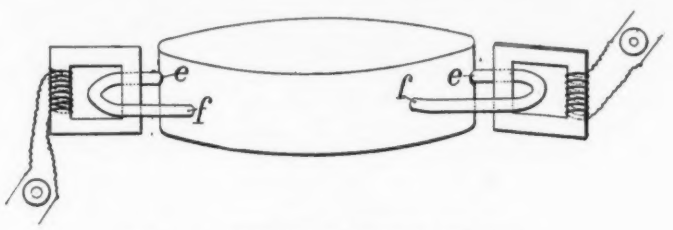


FIG. 1.—SCHNEIDER INDUCTION FURNACE.

electric power supplied to the primary is 165 kw, of which 87.5 kw are lost and only 77.5 kw are utilized in the secondary. The efficiency is, therefore, only 47 per cent.

In a patent, granted on June 7, G. P. E. Schneider, of Le Creusot, France, remarks that if the secondary (i. e., the charge to be treated) is made in form of a single ring of uniform cross-section, the current induced in it will be unnecessarily high and the reaction of this current upon the primary coil will produce an unfavorably large phase difference in the primary circuit. Schneider proposes, therefore, to increase the resistance of the secondary by making it in form of a tube of small cross-section, communicating at its both ends with a crucible of large dimensions containing the greater part of the charge. The latter part of the charge will then be at a considerably lower temperature than the charge in the tube. The one end of the tube is at a higher lever than the other end. Under the influence of the difference in density of the charge in the tube and in the crucible, an active circulation of the charge will result. The general principle of his idea will be seen from Fig. 1, which shows one large crucible in combination with two induction furnaces; one of the ends, *e* and *f*, of the tubes is at a higher level than the other. It is, of course, also feasible to have both ends at the same level, and to provide means for tilting the furnace chamber whereby the line joining the outlet and inlet of the tube may be thrown out of the horizontal plane.

The specification of Schneider's patent also contains some interesting suggestions concerning the application of the electric induction furnace, not as a substitute for, but in combination with, ordinary metallurgical furnaces. This is quite a promising idea and should in no way be confounded with the several schemes of replacing our blast furnaces by electric furnaces for making pig iron. It is easy to concentrate by means of the electric current a high heat at a certain point and at a certain stage of the operation. Thus, in his recent presidential address before the American Electrochemical Society, Dr. J. W. Richards suggested the auxiliary use of electric heating to take off "the peak of the load," so to speak, in our open hearth steel furnaces; that is, to furnish the last few hundred degrees of necessary temperature, while the combustion of gas furnishes the lower range.

Schneider's patent specification contains several suggestions of this kind. We may mention only the combination of the induction furnace with a blast furnace. Fig. 2 shows the vertical and hori-

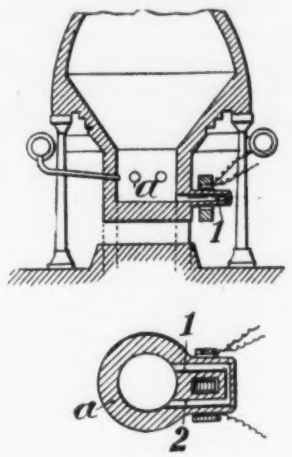


FIG. 2.—SCHNEIDER INDUCTION FURNACE.

zontal cross-section of a blast furnace, the crucible, *a*, of which is provided with the heating tubes, 1 and 2. The crucible, *a*, may thus be supplied at any stage of the operation with additional heat by electrical means. The electrical energy could be easily and cheaply provided by using part of the blast furnace gases for the operation of gas engines coupled to electric generators.

BATTERY INVENTION.

A patent granted to J. von der Poppenburg refers to the construction of a storage battery plate, in which cross pieces adapted for dividing or separating the active material protrude from the frame on both sides and are provided with holes at the part protruding from the frame; through these holes pass elastic bars, which press or bear against the protecting strips that prevent the active material from dropping off. The object is to obtain, in case of an expansion of the active material, only a bending of the elastic bars and to prevent the formation of wide cracks.

Two patents granted to G. F. Atwood refer to the composition in specific proportions of the two solutions used in the two compartments of primary batteries of the Bunsen type.

MISCELLANEOUS.

A patent, granted to H. Blackman, refers to the construction of an anode for use in electrolysis of sodium chloride. It is an iron or steel plate, the surface of which is completely covered with a dense layer of iron oxide. Several methods of producing this cover of oxide are described. This anode is stated to be incorrodible, except at the surface of the electrolyte. At this point it is, therefore, provided with a protecting band of glass of vitreous glaze.

A patent granted to G. Cornara refers to the production of explosive cartridges by producing explosive gas mixtures by electrolysis and igniting the mixture by an electric spark. As electrolyte he uses an aqueous solution of caustic soda or potash; the gas produced is, of course, a mixture of hydrogen and oxygen. Applications to blasting holes formed in rock and for projective torpedoes are described.

The Metric System in Great Britain.

The House of Lords of the British Parliament has passed a bill establishing the metric system as the legal system of Great Britain. It is confidently expected that the bill will be passed by the Commons at the next session, almost a majority of the members having committed themselves as in favor of the system.

Ohio Independent Telephone Association.

About 200 independent telephone men attended the meeting of the Ohio Independent Telephone Association, held at Columbus recently. An address of welcome was made by H. A. Lanman, president of the Columbus Citizens' Telephone Company, which was responded to by G. P. Thorpe, attorney of the Wilmington Home Telephone Company. Mr. J. B. Hoge, of Cleveland, then addressed the convention outlining a plan of organization. Two hours were profitably spent in discussing various subjects that had been placed in a "Question Box." Cyrus J. Huling, of Columbus, made a report on the post-office telephone fight, which was made in Washington last winter, showing how the independents had carried their point.

The committee on permanent organization presented a set of rules and regulations for the government of the association, after which the following-named officers were elected: President, Frank L. Beam, Columbus. Vice-presidents—W. Wilber Thompson, Lebanon; G. P. Thorpe, Wilmington; James B. Hoge, Cleveland; R. E. Hamblin, Toledo; J. C. Reber, Dayton; Dwight E. Sapp, Mt. Vernon; G. A. Mathany, Lima; W. F. Laubach, Akron; J. B. Rhodes, Zanesville; E. E. Knox, Portsmouth, secretary, and Ralph Ramer, Columbus, treasurer and assistant secretary. An executive committee consisting of five members, of which the president is ex-officio chairman, is yet to be appointed.

The plan of organization is to divide the State into nine districts, each vice-president to take charge of a district and organize the same so as to make a complete union of interests. Reports to the convention showed a very satisfactory condition throughout the State.

Mr. Harry Gates, of the Queen City Telephone Company, Cincinnati, made an interesting report stating that work had been commenced on the Cincinnati plant, and that they expected to have their plant in full operation inside of the next two years. He said that franchises would be asked for immediately in all adjoining suburbs.

Municipal Ownership in Canada.

In the return of reproductive undertakings operated by municipalities in Ontario, it is stated, in an official report, that out of 14 cities, 106 towns and 134 villages, to which forms of inquiry were sent, returns had been received by the 18th of November, 1903, from 12 cities, 90 towns and 118 villages. Of these, 11 cities, 57 towns and 21 villages had been carrying on reproductive undertakings and a number of the others reported that they were about to acquire waterworks or electric lighting plants. There are 79 municipalities in Ontario which own their water works, 35 which have their own electric lighting plants, 4 which supply electricity, 2 supply gas, 2 have municipal cemeteries, 1 possesses a dock, and 1 operates its own street railway. There was an average annual loss on the municipal street railway and electric lighting system combined at Port Arthur of $1,370.95, for the period of four years ended December 31, 1902. Profits are shown in 44 cases and losses in 48. In one case there was no profit or loss, and in 23 no reports were made. The municipal gas plant at Brockville, which was established in 1901, realized an annual profit of $4,000 on an invested capital of $85,000, but the natural gas sold by the corporation at Kingsville showed a loss of $243.38 on an invested capital of $27,000. The business of supplying electricity to consumers by municipalities has been begun too recently in most cases to admit of statistics of profit and loss. In Bracebridge there was an average annual profit of $620.28 on electric lighting and electric supply combined, which were first provided by the town in 1895; but at Hespeler, where the system was established in 1900, there was a loss of $3,084.60 on an invested capital of $15,483.48. There does not appear to have been any investigation as to the exact nature and realization of the alleged profits.

Telephony and Electric Light In New York.

A bright and amusing book on the United States, entitled: "Dollars and Democracy," has just been issued by the Appletons, from the pen of the portrait painter, Sir Philip Burne-Jones, Bart., who was over here not long ago. It is light and skittish in touch and makes no effort at serious discussion of American affairs, but makes many shrewd comments on public affairs, manners, society, etc. Sir Philip remarks that when he returned to British soil there were three things he missed above all: the domestic bath arrangements, the telephone service and the electric light. We feel we must quote him fully as to the last two:

"In New York and indeed generally throughout the United States, a telephone has become as necessary a part of the equipment of a well-appointed house as the aforesaid bath itself. The instrument is in constant use, and invitations to dinner and the opera are frequently transmitted by this expeditious means. How pleasant it is, when one feels lonely or depressed, to call up a friend and hear his cheerful voice across the city. In New York it is the exception not to have a telephone."

Sir Philip is even more emphatic about the electric light:

"The third thing I miss is the electric light—that really gives light. The bastard product of science and commercial enterprise known by the same name in London bears little resemblance to its transatlantic namesake. I think Broadway at night, with its myriad brilliant lamps, the names of its theatres and restaurants picked out in blazing points of electric fire, is a sight not readily to be forgotten, and one which impresses itself upon the imagination as much as anything in the great city of which it is the principal thoroughfare. The Waldorf-Astoria at night is also impressive at a respectful distance, but the effect on the spectator of them both is due to the brilliancy and purity of the electric light as manufactured in New York. I can do without 'rapid transit'; I can do without a 'quick lunch' (the very words give an indigestion); but I now know what baths, telephones and electric light can be under the most favorable conditions—and henceforth I shall have a new standard in mind for all three which I fear has not yet been attained in England."

The Telegraph in Presidential Election Years.

When the Western Union Telegraph Company announced $157,000 decrease from last year in its net earnings for the quarter, most people, says the New York *Evening Post,* jumped to the conclusion that this reflected the vanished pool room business. A little reflection showed that, since bills for telegraph contracts are not settled daily, the effect of the discontinuance order of May 19 would hardly be left until near the quarter's end. The company's officers, however, ascribed the decrease to the fact that whenever a Presidential election approaches "business is dull and receipts of the telegraph company grow smaller."

This sounded reasonable. It aroused, however, some interesting queries as to another equally well-known tradition—namely, that the company prospers immensely during the campaign itself, because of the increased use of the telegraph. There is an easy way to ascertain the facts. Following is the increase and decrease in Western Union's net earnings for the last three quarters of each of the six past Presidential years. Comparison is made in each case, of course, with the year before:

JUNE QUARTER.

1900	— $51,803	1888	+$250,538
1896	— 182,649	1884	— 5,636
1892	+ 221,440	1880	— 85,536

SEPTEMBER QUARTER.

1900	+ $38,189	1888	+$400,468
1896	— 255,116	1884	— 166,832
1892	+ 49,623	1880	— 334,835

DECEMBER QUARTER.

1900	+$133,345	1888	+$426,660
1896	— 57,962	1884	— 239,584
1892	+ 105,751	1880	— 502,613

This is a rather perplexing exhibit, and seems to prove nothing very conclusively. It should, however, be remembered that 1896 was a year of great depression; and that in 1880 the two rival telegraph systems were slashing rates in a life and death struggle.

Chicago Lighting.

The Chicago City Council has ordered two bills to be prepared. One will enable the city to regulate the price of gas and the other will authorize it to own and operate gas and electric light plants and to sell gas, electric light and power. Mayor Harrison has taken the initiative in this proposed municipal ownership of public utilities, considering it advisable to strengthen the case of the city in its contentions in the courts, with a specific grant covering these points.

CURRENT NEWS AND NOTES.

NEW YORK STATE TELEPHONY.—The annual meeting of the New York State Independent Telephone Association will be held at the Genesee Hotel, Buffalo, on June 23 and 24. A number of prominent independents will be present and an interesting programme is being prepared, while a good attendance is expected. Mr. T. S. Lane, of Buffalo, is the secretary.

SUBMARINES FOR THE EAST.—It is said that the submarine electric boat *Protector* has been shipped eastward by the Lake Submarine Torpedo Boat Company for Japan, to be succeeded by others. Meantime the United States Navy is making elaborate tests of some of the latest Holland boats, of which it is also whispered shipments to the scene of war have been made. It is all very vague and indefinite, but the inference is that "something is doing."

NEW RÖNTGEN-RAY TUBE.—Dr. J. Mount Bleyer has announced that he has discovered a special class of glass peculiarly adaptable for Röntgen rays. He found on experimenting that this glass fluoresced bluish, and on making a number of crucial tests he discovered, much to his surprise, that a tube gave out bi-ultra-violet rays in combination with Röntgen rays, much richer than he had ever observed before from any tube made from other kinds of glass.

TROLLEY AND STEAM.—The *Wall Street Journal* has the following note: "A banker who has just returned from a Western trip says: "Railroad earnings in the central West are being affected by electric railway competition. In Ohio and Indiana electric traction is developing rapidly and is cutting into steam road passenger earnings. Within the past month sleeping cars have been put on the electric lines between Indianapolis and Columbus, and between Indianapolis and northern Indiana towns. The fare on electric sleeping cars, including berth, is less than the fare on steam roads."

CONTROL OF WIRELESS.—It is stated from Washington that the joint Army and Navy Board has postponed until next fall the consideration of the question of control of wireless telegraph systems operating along the coasts of the United States. The army members of the board informed the naval members that they were not ready to make a report at this time, owing to pressure of other duties. The proposition came up on a request of the navy for the co-operation of the army for the control of wireless systems to be under the direct supervision and management of the navy, while the army officers of the joint board did not submit any reports. Gen. Greely, the Chief Signal Officer, has submitted his views to the General Staff, advising against any interference whatever with commercial line systems of wireless telegraph, maintaining that, in case of war, the government would take control of such systems, as it would of telegraph and cable lines operated in or to and from the United States. Gen. Greely also points out that the signal corps is now introducing and operating a satisfactory system of wireless telegraphy at different points, which it is proposed to use as a part of the signal corps' regular work. The indications are that the army is in no hurry to accede to the proposition of the navy. This whole subject has recently been fully discussed in these pages.

LETTERS TO THE EDITORS.

Electrical Trade With South America.

To the Editors of Electrical World and Engineer:

SIRS:—We are constantly in the market for electrical supplies of all kinds and should like to have catalogues and lowest export prices on such goods. Of course, we are in possession of the addresses of some American factories, but we should like to have others to compare prices. However, we would mention that quotations should in all cases be given f.o.b. vessel, New York. We now have before us a number of catalogues from different concerns in the United States and would probably have sent for some of these goods, but we are unable to compute freight from point of shipment inland to New York. All our European quotations are based f.o.b. Hamburg. We can thus easily figure total cost, which is impossible on, say, a shipment originating in one of your central States, like Ohio or Illinois, on account of not knowing rates from these points to New York. In the case of electrical novelties it would also be advisable to send a sample, so that one can judge if the article is worth importing and at the same time get correct import duty. We do not mean by this, however, that we expect manufacturers to send articles of value, merely as samples.

Now regarding the addresses of correspondents. Invariably letters coming from the United States with few exceptions have simply the name of addressee and Buenos Ayres, S. A. In the case of first-class mail, this is not so bad, but on printed matter such as catalogues, etc., nine cases out of ten they are not delivered. Buenos Ayres has a population of nearly a million, and the postal service is tolerably good here in the capital; but such punctuality or exactitude as in Europe, or as we suppose also in the United States of America, is not practiced here. Therefore, especially all catalogues should in all cases have full street address or post-office box "Casilla Coreo" number.

BUENOS AYRES, S. A. JENS HOLM HANSEN.

A Suggestion for Independent Telephone Companies.

To the Editors of Electrical World and Engineer:

SIRS:—The growth of independent telephony has often been pointed out in your columns, and no one who in any way tries to keep in touch with this interesting movement can fail to realize that as far as local service is concerned, the development has been very gratifying. This does not mean that the writer necessarily is a believer in competition in telephony, but as "we are confronted with a condition and not a theory" in the matter, an impartial observer likes to see the service of both Bell and independent organizations improved in every possible way.

There is no doubt that some of the independent people are making vigorous efforts to extend their long distance connections. It probably will not be long before the Middle West and the Atlantic seaboard will thus be in communication. Such a far-sighted policy is a mark of broad progress, and to one who stands outside the telephone business it is significant of commendable enterprise.

The point which I wish to make is, that many of the smaller independent companies do not as yet realize the full benefit of exchanging business with their neighbors or of offering through toll connections to distant points. The situation is, in many communities, a good deal like that which characterized the electric railway field about ten or fifteen years ago, when interurban lines were few and far between, and service between neighboring cities was of the haphazard variety, if indeed there was much of any service at all. The different independent companies use a great variety of apparatus; overhead line construction is in numerous cases little adapted to long distance conversations, and the traffic arrangements between adjacent organizations offer an attractive field for improvement.

It would seem that much progress toward more extensive business and greater profits might be made by some of the independent companies if they would settle down to a common basis of operating their systems. Certainly the various independent conventions have done much to foster an esprit de corps among competitors of the Bell organization, but in the writer's opinion it is better to adopt other methods than abuse in trying to gain a foothold in any given community. Good service at reasonable rates is the thing which counts and not an indiscriminate hurling of unpleasant epithets at one's rivals.

How can this common basis of operating be secured? There are several means of attaining it, but the writer believes the best course to be one which is comparatively undeveloped at present. We can take a leaf from the centralized control or better management of electric railway, power and lighting systems in finding the answer. It is a well-known fact that small systems of every kind usually have little extra money to pay for expert advice and oversight. As a result, the service is generally much below the standard set up by large and prosperous companies. If, then, several independent telephone companies will pool their issues and unite in securing the advice of some recognized expert in each branch of telephone work, they can secure many of the advantages of expert management at a comparatively small outlay for each individual company. Thus, in matters of engineering, it would certainly be profitable for a consulting telephone expert to advise, say, a dozen small companies at one or two hundred dollars a year apiece, and it would be an immense advantage to the different companies. In a small organization, the engineering problems which require expert knowledge of the highest order in their solution do not come up often

enough to make it profitable to employ a permanent engineering staff in daily work, but when these problems do arise, the entire future of the company's business may depend upon a correct and skilled solution. Inasmuch as only a comparatively small part of such a consulting engineer's time is required to attend to the wants of each particular company, the arrangement may be highly profitable to all parties concerned. In the same way the traffic problems may be laid before an expert retained by several different independent companies, who will guarantee to increase the business of each company by at least the amount of his retaining fee, or else charge nothing for his particular service. Legal advice, also, is open to the same possibilities.

All this does not signify that a centralized financial control is essential—only a concentration of expert advice. The principle of sharing something by individual contribution which would in itself be too expensive for individual maintenance in its entirety is an old one in economics, but the writer believes it is not sufficiently realized in the independent telephone field of to-day. As an advocate of increased efficiency in every kind of electrical service the writer feels justified in calling the attention of the independent telephone world to a method of improving its service which is bound to produce results, if care is exercised in choosing the expert who will divide his services among the united companies who employ him.

CHICAGO, ILL. CHAS. L. ROBERTS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Voltage Drop in Direct-Current Generators.—BEHN-ESCHENBURG.—An illustrated article in which he first compares the relative merits of two methods devised by him and Rothert, respectively, for determining the voltage drop in an alternating-current generator. The characteristic feature of his own method is that from the short-circuit curve of the generator different values of the internal impedance are calculated for different degrees of saturation of the magnetic system. These values of impedance multiplied with the current are then assumed to give the counter e.m.f. The error of this method is the supposition that the magnetic reluctance of the system for a certain e.m.f. of the magnetic coils excited by a direct current is not influenced by the m.m.f. of the secondary winding carrying alternating current. This supposition is correct as long as the magnetic reluctance is approximately constant, i. e., as long as the curve of the voltage of the generator, as function of the excitation, is approximately a straight line. The supposition is also approximately correct for strongly saturated generators, if the magnetic saturation is essentially produced by stray fields which cut the magnetic coils, but not the secondary coils, or on the other hand if a large amount of the magnetic field of the secondary coils does not cut the primary magnet coil. Rothert's method also uses the short-circuit curve; he therefrom calculates the equivalent of the m.m.f. of the magnet coils, corresponding to a certain counter m.m.f. of the loaded secondary coils. Here the supposition is made that the magnetic reluctance of the total system remains constant if the sum or difference of the m.m.f. of the magnet coils and of the m.m.f. of the secondary coils, as derived from the short-circuit current, remains constant. This supposition is fulfilled as long as the magnetic reluctance of the generator remains approximately constant; it is also fulfilled if the total magnetic fluxes produced by the magnet coils cut the secondary coils without stray fields, and if the total magnetic fluxes of the secondary coils cut the primary coils. Both methods are, therefore, not exact. The author gives a simple mathematical treatment of the subject and shows how by a simple correction the results obtained by both methods may be rendered correct. —*Elek. Zeit.*, May 19.

POWER.

REFERENCES.

Charging Gas Retorts.—GUARINI.—An illustrated description of electrically-driven machines for charging gas retorts with a uniform layer of coal of suitable size, at a speed which can be regulated, and without scattering or wasting the material.—Lond. *Elec. Rev.*, May 20.

Boilers.—A long report of competitive tests made between two different types of boilers at the plant of the Pacific Light & Power Company, at Los Angeles, Cal.—*Jour. of Elec.*, April.

Steam Turbine.—FALLEY.—A brief illustrated article on the De Laval steam turbine.—*Rose Technic.*, May.

TRACTION.

Leicester; an Automatic Reversible Booster.—An illustrated description of the municipal electric tramway system of Leicester recently described in these pages, which gives information in detail relating to the storage battery auxiliary. The battery consists of 240 cells, capable of giving 600 amp. for one hour, or 900 amp. for short periods; it can be charged normally at 270 amp., or at 450 amp. for short periods. An automatic reversible booster set is provided which consists of a shunt-wound motor, fed from the bus-bars, and a differentially-excited booster, directly coupled on one bed plate. The booster is connected in circuit with the battery and is used for raising the bus-bar pressure to the amount required for charging the battery or for raising the pressure of the battery when discharging. It is rated to give a current of 250 amp. at 130 volts on the charge, and 600 amp. at 70 volts on discharge. The machine is capable of dealing with an overload of 25 per cent. at any pressure between 20 and 70 volts, and delivers the above-mentioned currents at any pressure between zero and the maximum pressure indicated. A shunt-wound motor, working at 500 volts and running at a speed of 650 to 700 r.p.m. is employed, and the set is provided with the necessary auxiliaries, switch gear, etc. One of the main features of this system is the use of the Thury automatic pressure regulator for automatically maintaining a constant load on the generators running in parallel with the battery. The booster armatures are drum-wound with a slightly channeled core, and the coils are held in by driving horns, a double-wound armature is employed, and each winding is connected to a commutator, one at each end of the machine. The two armature coils can be connected in series or parallel as required. In the design of the reversible booster special attention has been paid to meeting the rapid changes of load and voltage without sparking. With these armatures the winding on the smooth core is placed as near as possible to the periphery and with the tangentially-arranged field coil the iron in the field magnets is reduced to a minimum. The combined efficiency of the reversible booster set is 81 per cent. After a six-hours' run at full load the temperature rise does not exceed 70° F. Fig. 1 gives a diagram of connections of the Thury auto-

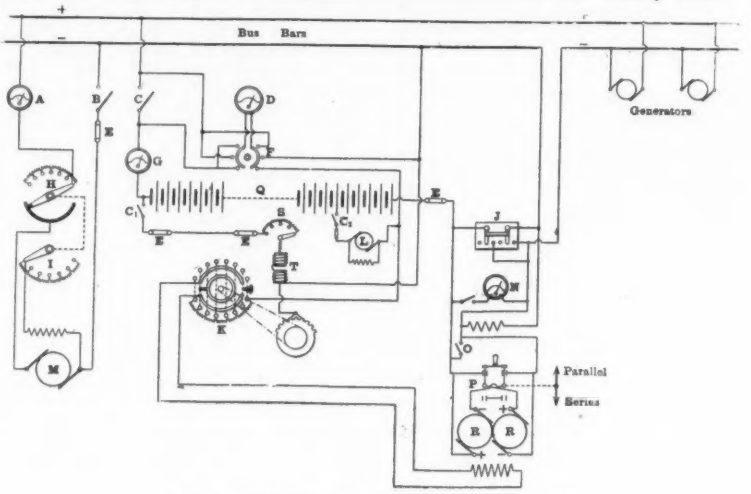


FIG. 1.—DIAGRAM OF REVERSIBLE BOOSTER.

matic reversible booster system. *A* is an ammeter, *B*, *C*, C_1, C_2, *F*, switches; *D* a voltmeter, *E* a fuse, *G* the battery ammeter, *H* the starter, *I* rheostat, *J* the booster reversing switch, *K* automatic reg-

ulator, *L* regulator motor, *M* motor, *N* booster voltmeter, *O* reverse-current cut-out, *P* a two-way switch, *Q* the battery, *R* the booster with two commutators, *S* a rheostat solenoid, and *T* a regulator solenoid.—Lond. *Elec.*, May 20.

REFERENCES.

Canton-Akron Railway.—A description of an extensive interurban railway in Northern Ohio. All dispatching is done by telephone. Every car carries a portable box telephone, which may be used at any point on the line on tapping the telephone wire by means of a long bamboo rod carried on the car. In addition to passenger traffic, the company does some express business.—*St. R'y Jour.*, May 28.

Trolley Harp.—An illustrated description of a trolley harp, the principal feature of which is the method by which the wheel is enabled to turn freely in going around curves. The loose mounting of the bearing blocks permits the trolley wheel to twist in the forks of the harp, one of the bearing blocks remaining stationary and the other sliding forward until it abuts against one of the retaining levers. The trolley wheel shaft is held against rotation as it is formed integral with one of the bearing blocks.—*St. R'y Jour.*, June 4.

California Railway.—Some notes on the San Diego & Coronado line in Southern California, which has some novel features, among them the use of a double-deck car. Owing to the distance from large manufacturing plants a number of repair shop tools have been developed. Oil is used as fuel.—*St. R'y Jour.*, June 4.

Electric Power in Metallurgical Plants.—The first part of a profusely-illustrated article on electric aerial suspended tramways for quickly transporting materials from one part of a metallurgical plant to another. The system described is that of Kolben & Co. for special use in iron and steel works.—*Elek. Bahnen.*, May, No. 10.

Electricity for Mine Hoists.—An illustrated article on electrically-operated versus steam-driven mine hoists. Some examples from various plants are described. The losses in steam pipes, operating pumps, ventilators, hoists and other mining machinery by engines of small capacity, as well as the low efficiency of these engines, make the use of electric power preferable.—*Sc. Am.*, June 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Rapidly-Growing Western Central Station.—BARTH.—An illustrated description of the generating plant of the Kansas City Electric Light Company, which had in 1899 a maximum load of 900 kw, while in 1903 it was 3,400 kw. The growth was so rapid that many makeshifts had to be resorted to. The company had a number of stations throughout its territory, with no less than 42 generators of various sizes and makes. The new station was finished in 1902, the equipment consisting of six double-deck water tube boilers rated at 514 hp fitted with traveling link grates, a traveling coal conveyor and ash remover being also installed; two 2,250-hp Allis-Chalmers vertical cross-compound engines drive 1,500-kw, 6,600-volt, 25-cycle alternators. The station supplies all the current for the series arc lights in the western part of the town and in the immediate vicinity. All of the 60-cycle alternating current for incandescent lamps is also furnished from here and the 6,600-volt, 25-cycle current is carried to uptown sub-stations, which are described. As the company has had so many different types of stations under its control, under similar conditions as to wages, price and quality of coal, and efficiency of management, it has determined the relative economy of the different apparatus. Data are given in the article. On May 31 the station was flooded by the rising of the Kaw River, but current was again on the lines eleven days after the flood, and the only loss which could be traced to the flood was some small potential transformers, which did not receive the proper amount of care in the drying-out process.—*Am. Elec.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Conductivity and Fluidity.—HOSKING.—In a former investigation the author has found that the specific molecular conductivity and the fluidity of the solutions investigated by him became zero at the same temperature, viz.: 35.5° C., this result being obtained by extrapolation. Another general result obtained by him was that the fluidity-concentration isothermals and the conductivity-concentration isothermals all cut the axis of zero fluidity and conductivity respectively at the same point, representing a concentration of 10.74 normal. The author has now made an extended study of lithium chloride solutions. He finds that both the fluidity and conductivity values can be expressed by equations of the same form, and that they are proportional to the *m*th power of the temperature measured from a fixed point below zero degree C., which is the same for all solutions. This temperature is 48.10° C., while *m* varies for the different solutions. He makes some remarks on Kohlrausch's hypothesis that ions in aqueous solutions are surrounded by watery atmospheres carried along with them and the resistance the ions have to overcome is mainly friction between this atmosphere and the solvent water.—*Phil. Mag.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Gold Refining.—WOHLWILL.—An illustrated article on his electrolytic process of gold refining, which is now in use in the Philadelphia Mint. Its main features are the addition of hydrochloric acid to the electrolyte of gold chloride and the use of an elevated temperature. If the anode is gold containing platinum, both gold and platinum pass into the solution, but only the gold is deposited upon the cathode. The platinum can be precipitated from the solution afterward in a very simple way. The author points out that all natural silver and gold contain platinum, and that the refiner should endeavor to recover the platinum, which can be easily done by electrolysis. He also speaks of iridium and palladium.—*Electrochem. Ind.*, June.

Extracting Copper from Ores.—JONES.—An illustrated paper on the methods of leaching and precipitating copper, in use at Rio Tinto in Spain. Huge heaps of the mineral are allowed to oxidize under the influence of moisture and air and subsequently the copper sulphate is washed out as soon as it is formed by running water through the heap. The liquor is run into the precipitation tanks over pig iron to precipitate the copper in the form of so-called cement copper. While thus the process does not contain the application of an electric current, some of the reactions are electrochemical in nature, due to the occurrence of galvanic couples in the tanks. The method of working is described in detail.—*Electrochem. Ind.*, June.

Chemical Applications of N-Rays.—COLSON.—In a continuation of his researches in which he observed that N-rays are given off during certain chemical reactions and that they can be utilized as a physical criterion for such actions he has now found that the chemical reactions which give rise to N-rays are invariably accompanied by some physical action such as contraction or cooling. Some very vivid chemical reactions, such as a precipitation of salts are not accompanied by any evolution of N-rays, so that there is evidently no proportionality between the chemical action and the evolution of N-rays. It is just this lack of proportionality which makes the N-rays valuable to the chemist, since he is thus enabled to discover actions which may be masked by the more evident chemical reactions.—*Comptes Rendus*, May 21; Lond. *Elec.*, May 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Multipolar Electrostatic and Electrodynamic Instruments.—MORRIS.—In the discussion of Duddell's paper abstracted in the Digest last week, he said that the working forces in an electrostatic instrument could be increased by limiting the angular range without increasing the amount of inertia of the moving system. For instance, this can be effected in the quadrant electrometer with a wide needle by subdividing the quadrants in a similar manner. The needle would then have the same total moment of inertia as before. If the fixed quadrants are similarly divided into sectors, then the working forces are increased. The force available for use depends upon the angular rate of change of capacity of the needle; and although by the change described, the actual capacity (and therefore the capacity current) have not been increased, yet a very small angular movement is required for the needle to pass from the position of maximum capacity to that of least capacity. The limit to this process of subdivision in the case of zero or small deflection instruments is decided by the practical working clearance, the clearance being determined by the tilting of the needle due to unbalanced electrostatic forces. Small charges on the parts due to contact potential differences render low-voltage electrostatic working very troublesome. Both these troubles are, however, simultaneously avoided by using a separate needle attached to and in the same plane as the other, but insulated from it, and connected electrically with the other set of sectors. On this principle an instrument was constructed of a cylindrical type. In order to measure small alternating-current voltages on an ordi-

nary potentiometer, the needle was brought back to zero by a small direct current, flowing in a little dynamometer coil attached to the mirror. These principles have been adopted in some of Addenbrooke's sensitive electrostatic instruments. Such an instrument might be called a multipolar electrostatic instrument, and he has used the same idea in the construction of a multipolar electrodynamic instrument. Air is, after all, but a poor conductor for magnetic lines, and there is no reason why it is necessary to provide enough coils to send a reasonable flux into spaces such as the center of a dynamometer or wattmeter of any given type where the flux is not wanted. This only causes inductive error. He supposes that the inductive errors depend very nearly upon the volume of the space, which is filled with the alternating flux. The sides of the moving coil of an ordinary dynamometer, or even of a modern high-class wattmeter, occupy but a small part of the space so magnetized. If, however, both the fixed and moving coils are wound multipolar, then, though the angular range is restricted, the sensitiveness might be increased and the inductive error clearly very much reduced.—Lond. *Elec.*, May 20.

Measuring the Effective Resistance and Inductance and the Energy Loss in Alternating-Current Apparatus.—Dolezalek.—An illustrated description of a method based on the principle of the Wheatstone bridge. The apparatus, the effective resistance and inductance of which are to be determined, is placed in series with a non-inductive resistance box in one arm of the bridge. The ordinary galvanometer of the bridge is replaced by a telephone, in order to send first alternating currents through the system. Balance is first obtained by sliding one terminal contact of the branch which contains the telephone along a measuring wire and by adjusting the resistance box. The alternating current is then disconnected and a galvanometer substituted for the telephone and direct current is sent through the system. The current in the galvanometer branch is brought to zero by adjusting the resistance box. This last adjustment gives directly the difference of the effective resistance of the apparatus for alternating current and the ordinary ohmic resistance. This difference is due to the hysteresis and eddy-current losses, etc. If it is multiplied with the square of the current one gets the loss due to hysteresis, eddy currents, etc., in watts per second.—*Elek. Rund.*, May 15.

Telegraphy, Telephony and Signals.

Alarm Bells Tuned to Alternating Current of Given Strength or Given Frequency.—Baumann.—In the continuation of his article, the first part of which was abstracted in the Digest last week, the author first described the use of alarm bells tuned to a certain strength of alternating current. The principle is shown in Fig. 2.

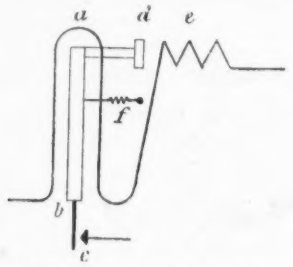
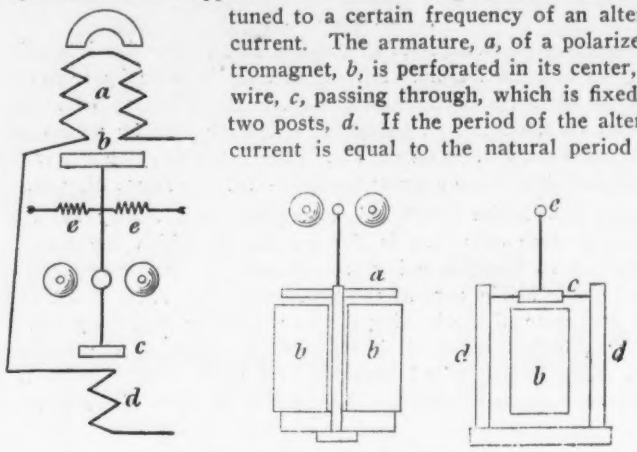


FIG. 2.—ALARM BELLS.

A relay is provided consisting of two coils, *a* and *e*. One of them, *a*, surrounds a permanent magnet, *b*, which can revolve in a horizontal plane. The one terminal of the permanent magnet has a torque which closes the contact, *c*, when it is displaced under the action of the current; at the other end of the permanent magnet a perpendicular piece of soft iron, *d*, is provided which is opposite to the pole to the electromagnet, *e*. If an alternating current passes through both coils, the permanent magnet is subjected to two actions. The coil, *a*, tries to remove the permanent magnet out of the plane of the coil while the action from *e* and *d* tries to hold the magnet. In the same sense spring *f* is acting. The first force is proportional to the current, the second is proportional to the square of the current, while the third is constant. It can be easily shown mathematically that the magnet is deviated only if the current is between two certain limits. A tuned bell, based on the same principle, is shown in Fig. 3; *a* and *d* are electromagnets. The springs, *e*, try to hold the clapper of the bell in its central position. If the current is small, the clapper remains at rest. If it is increased *a* will act on *b* and the bell will ring. If the current is further increased the action of *d* upon the soft iron piece, *c*, will be greater than the action of *a* upon *b* and the clapper will be at rest. Fig. 4 shows an alarm bell tuned to a certain frequency of an alternating current. The armature, *a*, of a polarized electromagnet, *b*, is perforated in its center, a steel wire, *c*, passing through, which is fixed at the two posts, *d*. If the period of the alternating current is equal to the natural period of the



FIGS. 3 AND 4.—ALARM BELLS.

oscillations of the system, *a*, *c*, *e*, it will begin to vibrate and the bell will ring. The natural period of this system can be easily adjusted by regulating the distance of the armature from the magnet poles and the torsion of the wire, *c*.—*Zeit. f. Elek.* (Vienna), May 15.

Transmission of Pictures.—Ennsbruner.—An illustrated article on the electric transmission of photographs, pictures and writings. This has been tried repeatedly with the aid of the well-known property of selenium having a greater electric resistance in the dark than in light. The author describes the system of Korn. The features of this system are essentially the methods of keeping two rolls in synchronous rotation at the transmitting and receiving stations and to correct at certain time intervals any difference in synchronism. In the receiver he uses a vacuum tube, the radiation of which is changed by the currents received from the transmitter. At the transmitter the rays passing through a small part of the picture at any moment fall upon a selenium cell and cause its resistance to change.—*Elek. Neu. Anz.*, May 15.

Railway Signalling.—A description of the system of signalling adopted on the Boston and Worcester electric railway, by which the dispatcher can summon to the telephone any car crew and give orders. The telephone wires extend the entire length of the line, with instruments at all turnouts, and pads on which orders received by the car crew are written down in pencil and copies preserved in the box. Adjoining each telephone is a signal box containing semaphore signal, pendulum and magnet, each pendulum being of different length. The dispatcher in the main office, by means of a 75-mm. cog wheel, can send electrical vibrations through all of the electromagnets, and by timing the vibrations the pendulum whose period is synchronous with a period of the electromagnetic impulses will commence to vibrate, tipping the lock holding the semaphore in a vertical position. When the semaphore falls it closes a lamp switch giving the luminosity signal needed at night. After the motorman has reported to the main office and received his orders, he resets the signal to "clear."—*St. R'y Jour.*, June 4.

References.

Telephone Engineering.—Dommerque.—Another of his series of articles on telephone engineering. He treats of three kinds of protective devices used on telephone circuits; that is, lightning arresters, strong current protectors or fuses, and sneak current arresters or heat coils. Lightning arresters are to protect against atmospheric electricity and high-tension currents; strong current protectors or fuses, against currents of electric light, power and all circuits of moderate potential; heat coils, against sneak currents caused by leakage or poor insulation. The author describes the various devices on the market.—*Am. Elec.*, May.

Wireless Telegraphy.—Collins.—A long and well-illustrated description of the modifications and improvements which wireless telegraph apparatus have undergone since 1896. He describes the type of transmitter of 1896, various types of telegraph keys, induction coils, interrupters and spark-gaps, the type of receiver of 1896, various relays, decoherers, electric wave detectors, Marconi's magnetic wave detector, and various inductors.—*Eng'ing. Mag.*, June.

Cable Steamer.—A fully illustrated description of the cable steamer

Pacific, which has been built for the Great Northern Telegraph Company as an addition to its cable repairing fleet. Three cable tanks have been provided which will hold about 450 miles of deep-sea cable—say 1,000 tons.—Lond. *Elec.,* May 20.

MISCELLANEOUS.

Nerve Impulses and N-Rays.—CHARPENTIER.—An account of the investigation in which he has proven the existence of a wave propagation of nerve impulses and determines their wave length by means of N-rays. If, instead of using a single wire for the conduction of N-rays, two wires are used, their combined effect upon the screen is sometimes weaker and at other times stronger than the effect of a single wire. This suggested to him the existence of interference, and since the intensity of N-rays emitted by a nerve, is proportional to the activity of the nerve it was reasonable to suppose that the nerve impulses have a definite frequency and wave length. He therefore examined a nerve at two points by means of two wires of equal length and found that there was no effect upon the screen when the points were 16 mm. apart. This he considers to be half the wave length of the nerve impulses and their frequency is about 800 per second.—*Comptes Rendus,* May 2; Lond. *Elec.,* May 20.

Fire Hazards in Electric Plants.—KNOWLTON.—An article in which the author gives numerous detailed rules on precautions against the occurrence of fire in electric plants and on means of extinguishing the flame when once a blaze has started. He thinks that the greater proportion of fire hazards are preventable, and that careless operation is at the bottom of most of the trouble. Inside an electric plant water is of no value in putting out an electric fire, and for this reason automatic sprinklers are undesirable; extinguishers of the dry powder, chemical or compressed gas types, are far more effective for all around service. Fires caused by electric arcs are best beaten out by asbestos or woolen blankets, overcoats, towels, etc., or else quenched by the liberal use of sand. The entire wiring system ought to conform to the practice of the National Board of Fire Underwriters. To prevent confusion in case of a fire, due to the failure of the lighting current, either oil or candle lanterns should always be provided. An automatic fire alarm which will give warning of any unusual temperature rise beyond safe limits is a necessity in all plants which are divided into several rooms, such as telephone exchanges. A few hundred dollars go a long way toward completely protecting all but the largest plants from all fires except those which are unpreventable. —*Eng. Mag.,* June.

New Books.

THE THEORY OF THE LEAD ACCUMULATOR. By Dr. F. Dolezalek. Translated by Dr. Carl L. von Ende. New York: John Wiley & Sons. 252 pages, 30 illustrations. Price, $2.50.

This is a valuable and interesting little book, written along the lines of the newer electrochemistry and presenting a good summary of modern theory on the subject of the lead storage battery. It may be said in general to limit itself to the theoretical side of the topic, but there are many references to practical tests and results. The book is divided into some sixteen chapters, although some of these deal with tables and measurements. The three opening chapters discuss the subject from the standpoints of the chemical, osmotic and thermodynamical theories of the origin of current, not elaborately, but succinctly; still with sufficient clearness and fullness in proportion to other parts of the treatise. It is notable that German and English authorities are cited frequently; American are conspicuous by their absence. But who could blame the author for that? Other chapters treat of variation of electromotive force with acid concentration, and variation of electrode potential; temperature coefficient; influence of external pressure; behavior during charge and discharge; reversibility; changes in the open cell; internal resistance; capacity; degree of efficiency and working efficiency; changes in the cell during formation. A final chapter deals with methods of measurement, and there is also a table of density and percentage strength of mixtures of sulphuric acid and water. An excellent index is furnished.

AMERICAN STREET RAILWAY INVESTMENTS (The Red Book for 1904). McGraw Publishing Company, New York. 362 pages. Price, $5.

This valuable annual record of street railway investments has again made its welcome appearance, and maintains its growth and improvement in make-up and quality of contents. This year's volume is larger than ever before and contains reports of a considerable number of companies which hitherto have declined to present financial statements. In addition to a large increase of information of this character, the publishers have added a number of other useful features, among them the location of power stations and repair shops, parks and pleasure resorts, and much more complete descriptions of the funded debts of the different properties.

The volume also contains a large number of maps of the principal street railway systems in the country, many of them in two or more colors; also some novel and striking maps showing the interurban railways in New Jersey, Ohio, Indiana and Illinois.

The analysis of the earnings of the different properties as reported this year indicates that they have kept up in spite of the decrease in many of the steam railroads and manufacturing properties, and as a whole the industry can be said to be in a prosperous condition. In a comparison for 1903 and 1902 of the gross receipts of 310 companies, the average increase is 8.5 per cent. These figures vary, of course, in different groups or categories, but all the data go to show that the street railway industry to-day, as ever, demands new capital and material, and yields a fair return thereon. It is worth the while of any political or social economist to sit down for an hour or two with this handsome volume and master its many revelations and suggestions, as well as direct data, as to the course of electric transportation in America.

Cooley Rotary Engine.

An engine proof against the effects that usually follow neglect to properly lubricate, sudden turning on or off of power, reversal when under full speed, sudden flooding of water, unintelligent tightening up of wearing parts and lack of attention to ports liable to work loose, and which at the same time will still do its duty and maintain a fair degree of efficiency under the above conditions is claimed to be that made by the Cooley General Development Company, of Boston, and which we illustrate herewith. The simplicity of the engine is brought out in Fig. 1, showing the engine with the cylinder head removed and exposing the working parts. Fig. 2 shows all that there is of the working parts withdrawn.

When the engine is in motion the four short roller valves, *A,* roll upon the interior of the cylinder, thereby effecting a nearly frictionless condition of what would cause the greatest frictional loss with a block or slide valve when under centrifugal influence, the same influence in this case merely rendering more certain the rolling of the valves. The diameter of these valves is so proportioned to their length that binding at their extremities through canting is stated to be impossible, their end surfaces being sufficiently large to maintain alignment. They are practically the pistons of

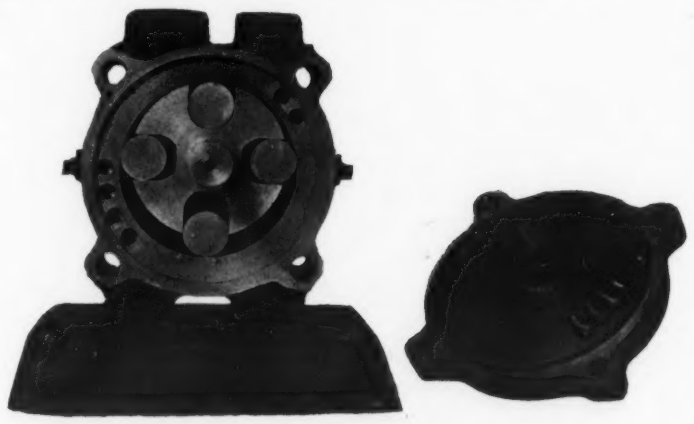


FIG. 1.—ENGINE WITH CYLINDER HEAD REMOVED.

the engine, their distances from the axis of the shaft determining when under steam pressure the leverage and effective piston area of the engine.

In Fig. 1 the upper and lower valves, being the greatest and least effective in causing rotation, may be used as an example. Steam pressing on both of these valves simultaneously from the right will cause a rotation of the engine in the direction of the movement of the hands of a watch because of the greater leverage of the lower valve. The upper valve acts to maintain a joint at the top, and as rotation continues, oppositely located valves consecutively perform

these functions. The slotted hub is of cast iron while the valves are of steel insuring fairly good wearing conditions. The cylinder is double, having an annular steam space within the outer wall and completely surrounding the inner wall except at the top and bottom, where partitions are provided to separate the exhaust from the entering steam. A steam jacket is thereby provided by which the inner wall of the cylinder is maintained at a temperature almost exactly equal to the temperature of the slotted hub and valves, thereby practically removing the serious drawback of differential expansion.

The slotted hub and the valves are slightly shorter than the cylinder, the latter being about 2/1000 of an inch shorter and the former 1/1000 of an inch shorter, in a 10-hp engine, which is sufficient to allow their free movement between the cylinder heads. The slight leakage of steam consequent to this condition is less than the amount of loss that would be occasioned by friction if mechanical joints were maintained between the heads and the working parts; the leakage is preferable because it allows cheaper construction, better

FIG. 2.—PARTS OF ENGINE.

economy and less likelihood of cutting and other troubles when oiling is neglected. The entrance and exit of steam are effected through the small holes in the upper right and lower left of counterbore of the cylinder end. They open at both ends of the cylinder, and both cylinder heads are grooved to allow the entrance of steam at both ends of the valves simultaneously and between the slotted hub and the valves as well as into the cylinder.

This method of porting insures a non-broken surface of the interior of the cylinder both while machining it and for the valves to travel over when in actual operation. The exhaust is of large area and free, the mere passing of the valves by the port grooves in the heads effecting a cut-off of steam between consecutive valves and resulting in a useful expansion of the steam which in the engine illustrated corresponds to about one-half cut-off.

Endurance tests have shown, it is claimed, that the engine will stand up and maintain good working conditions under shocks and strains that would instantly wreck a reciprocating engine or other motor of less rugged and enduring qualities. Below are the data of a test made at the shops of the New York Central & Hudson River

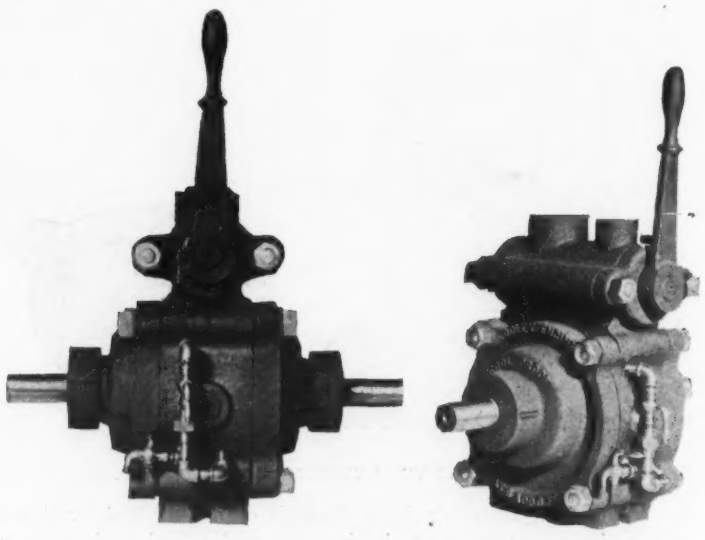


FIG. 3.—TWO VIEWS OF COOLEY ENGINE.

Railroad Company at West Albany: Duration of run, 7½ hours; boiler pressure gauge average, 98.13; average r.p.m., 1,249; total condensed water, 1,358 pounds; developed horse-power, 9.79; length of brake arm, 5¼ ft.; mechanical efficiency, 91 per cent.

The trial consisted of nine separate runs of one-half hour each, readings being taken every five minutes during each run. The exhaust steam was condensed in a surface condenser, the condensing water caught and weighed after each run. A separator was used to dry the steam, with a throttling calorimeter to detect the moisture present. Readings of the thermometer on this were taken every minute throughout the runs. The developed horse-power was measured by a Prony brake. The first run was made with no load to determine friction and thereafter a load increasing by one pound each run was put on.

Willard Storage Battery for Automobiles.

The accompanying illustrations, Figs. 1 and 2, show in detail the improvements lately made in the Willard storage battery. The Willard Co. has fully realized that one of the greatest troubles in vehicle batteries is due, not so much to the character of the plates, as to their tendency to short circuits, and that while the short circuiting from face to face of the plates has been corrected by the use of wood

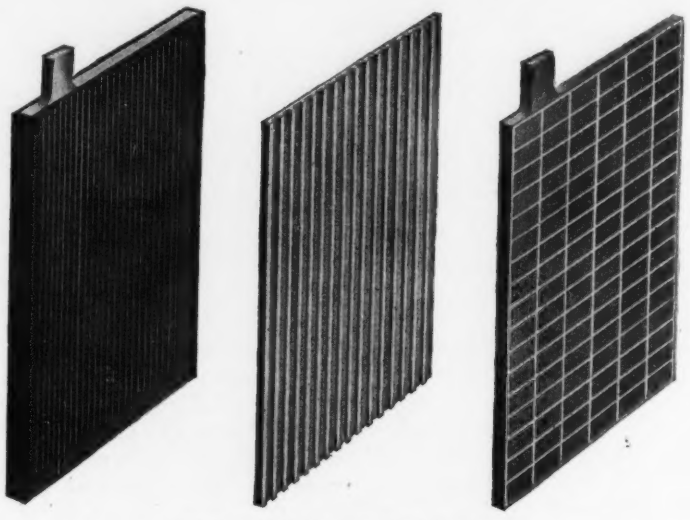


FIG. 1.—STORAGE BATTERY PLATES.

separators, there is still left the probability of the plates short circuiting around the edges and bottoms. This trouble has been corrected in a very simple and effective way by enclosing the positives in an envelope of hard rubber, finely perforated along the faces, but imperforate along the edges and bottoms. With this envelope or

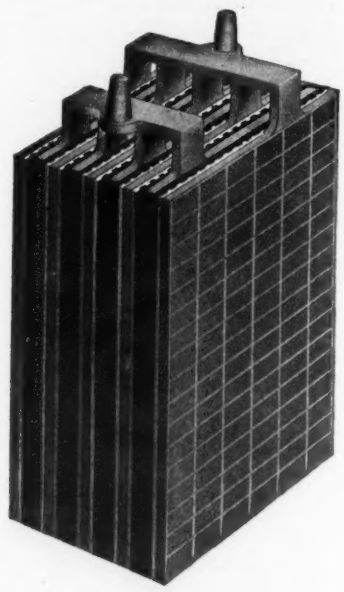


FIG. 2.—ASSEMBLED PLATES.

sheath, there is used a grooved, imperforate sheet of specially treated wood, thus, it is said, entirely doing away with any possibility of short circuit, either across the faces or around the edges of the plate, yet at the same time allowing free electrolytic action and circulation between adjacent plates.

The Willard Co. states that the sheath used with its positive plate is

not a new device, as it was successfully used several years ago in connection with its standard batteries, but that its cost at that time precluded any idea of its general use. The company has recently put in new apparatus for producing these sheaths and so reduced the cost as to make their general use practicable.

The company still uses its familiar form of Planté positive, consisting of a sheet of pure rolled lead having fine, vertical grooves, but has changed to a cage type of pasted grid for its negative plates, in this way adopting the particular combination of Planté and Faure plates, which experience has shown to give the highest voltage and longest life.

In the regular type of battery, the straps connecting the plates together are provided with pillar type terminals over which fit covers of molded and reinforced hard rubber. This system is found to do away entirely with the trouble experienced sometimes by the acid slopping and siphoning over the sides of the jars. Ordinarily the cover is sealed in with a compound which makes the jar practically acid-tight, but in some special types the jars are deeper and the covers set in lower down, without sealing. The nine-plate cell shown in the accompanying engraving weighs thirty-two pounds and has a capacity of thirty-six amperes for four hours.

Electrical Exhibits at the St. Louis Exposition.

The office of ELECTRICAL WORLD AND ENGINEER is elegantly and comfortably furnished for the reception of visitors. Complete files of its technical journals and a library of electrical books published by the McGraw Publishing Company are at the service of visiting engineers. A register is kept in which it is intended to have a complete record of all those interested in electrical industries who go to the Exposition. Comfortable and cosy seats and lounges are provided for any who wish to read and facilities are at hand for correspondence. The booth is below the office gallery of the Electrical Department, and its appearance may be noted from the accompanying illustration. It is a great centre and rendezvous for electrical visitors at the Exposition.

FIG. 1.—BOOTH OF "ELECTRICAL WORLD AND ENGINEER."

The Burdette-Rowntree Manufacturing Company has an exhibit of automatic electric dumbwaiters at the northwest entrance of the Electricity Building. The exhibit consists of two complete installations of push control electric dumbwaiters, one running at a speed of 150 feet per minute and the other at nearly 600 feet per minute. Both cars run from the floor to the highest part of the roof of the building. The high speed car is enclosed in glass and contains incandescent lamps that light up automatically when the car is in motion. The most interesting part of this exhibit is the automatic feature that makes the installation what the manufacturers call "fool-proof." The car is operated by means of push buttons, placed both on the enclosure work and on the adjacent desk. In actual practice, they can be located on every floor, so that the car can be operated from any floor, or only from one floor; and by this means one man only has control of its movements. Pressure for an instant on any button causes the car to start, and it automatically stops at the floor corresponding to the button depressed. It is not necessary to keep the finger on the button while the car is in motion. If a button is pressed while any door is open it will not cause the car to start, or while the car is in motion it will have no effect. One cannot open a door, if doorlocks are used, unless the car is at that floor. If doorlocks are not used, and the door is opened while the car is in motion, it immediately stops the car.

The car always automatically slows down before stopping and so comes to rest smoothly and easily. So perfectly is this done that in actual practice a glass brimming full of water can be placed in the car and a round trip made without spilling a drop. The high speed car is operated from the adjacent desk, and has also a signal lamp on the desk which lights up when the car is at rest, and goes out while it is in motion, or when any door is opened. The operator knows therefore the instant the car starts, the instant it has reached the floor to which it was sent, the instant the door is opened by the attendant on that floor, and when the door is again closed and the car is ready for use.

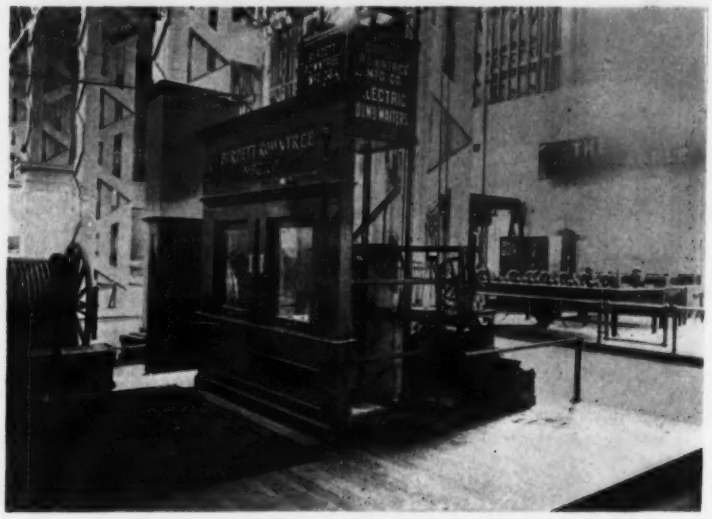


FIG. 2.—BURDETTE-ROWNTREE EXHIBIT.

Just across the aisle is a complete operating exhibit of the Dayton Electrical Manufacturing Company. A Fairbanks-Morse 20 hp gas engine is direct coupled to a 200-light dynamo, which supplies the current for operating the exhibit and lighting the large sign. This engine is ignited by either jump spark, touch spark or the new Apple electric flame at the option of the operator. On the switchboard a new design ignition meter shows the number of charges taken in by the engine and the number of charges ignited by each of the three systems mentioned above, thus showing the comparative merit of each. On a long table there are one dozen flywheels of various sizes operating 24 ignition dynamos fitted with Apple gov-

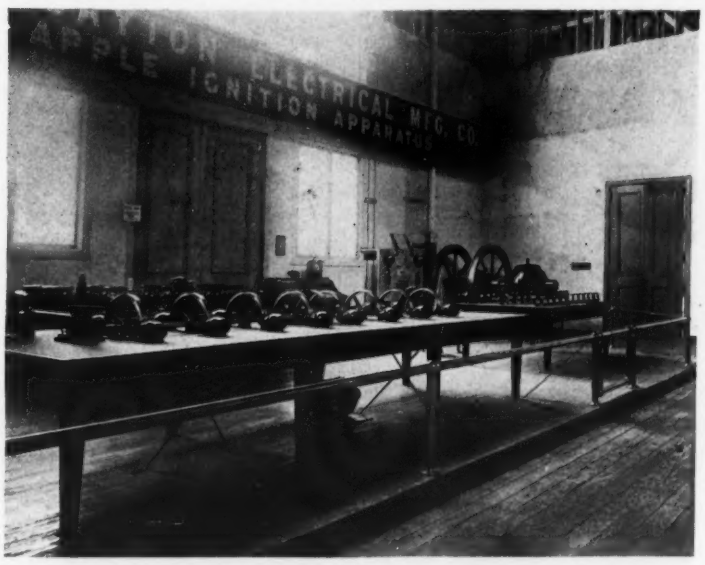


FIG. 3.—DAYTON ELECTRICAL MFG. CO. EXHIBIT.

ernors that maintain the speed of the dynamo constant no matter how fast the gas or gasoline engine may run. In addition are shown storage batteries, jump spark coils, contact coils, plugs, timers and magnetos made by this company. It is a very interesting exhibit.

One of the operating exhibits to which all are attracted is the Hall model electro-plating establishment in the west doorway of the building. The complete operation of gold and silver plating is shown from cleaning the metal surface, depositing the coating, cleaning and polishing. Perhaps the most interesting feature of this exhibit are the electro-plated leaves, fruit and flowers and other non-metallic substances. By a special process there is deposited upon the surface a copper coating, and then the gold or silver plating can be quickly done. The cleaning and polishing is done within glass cases so that the dust and dirt attending such work is entirely absent.

In the Robbins & Myers space a very creditable showing is made of a line of their "Standard" motors and dynamos These machines are shown in sizes from 1-30 to 15 hp, and these cover the capacities built by the company. One machine is disassembled to show the methods of construction, insulation and the interchangeability of parts. The unique feature of the entire exhibit is an immense revolving fan motor rack. A rack with six arms rests on a ball-bearing upon a center post. From extremities of each arm is suspended a ceiling fan, and above each arm is a desk fan with the plane of the fan nearly parallel with the arm. With the twelve fans going, the desk fans cause the entire rack to revolve, which keeps the air of that entire section in circulation. Another interesting exhibit item is a magnetic separator used for extracting particles of metal from cotton before it reaches the gin.

The generator and motor exhibit of the Triumph Electric Company covers a wide range of application. Power for operating this exhibit is derived from a Warren synchronous motor driving a 35-kw, 220-volt Triumph generator. There is also a Fairbanks-Morse vertical gas engine direct connected to a 7½-kw, 220-volt generator, this set being a good example of the minimum floor space required for a small power station. A motor generator set takes current from the above source and delivers 10 kw at 500 volts. A number of tools are shown in operations illustrating the method of connected Triumph motors to same. A Fay & Egan band saw is driven by a motor and intended for one speed only. The motor-driven Bickford radial drill is regulated by a Cutler-Hammer drum starter and controller. A Lodge & Shipley lathe is similarly equipped and in operation. All

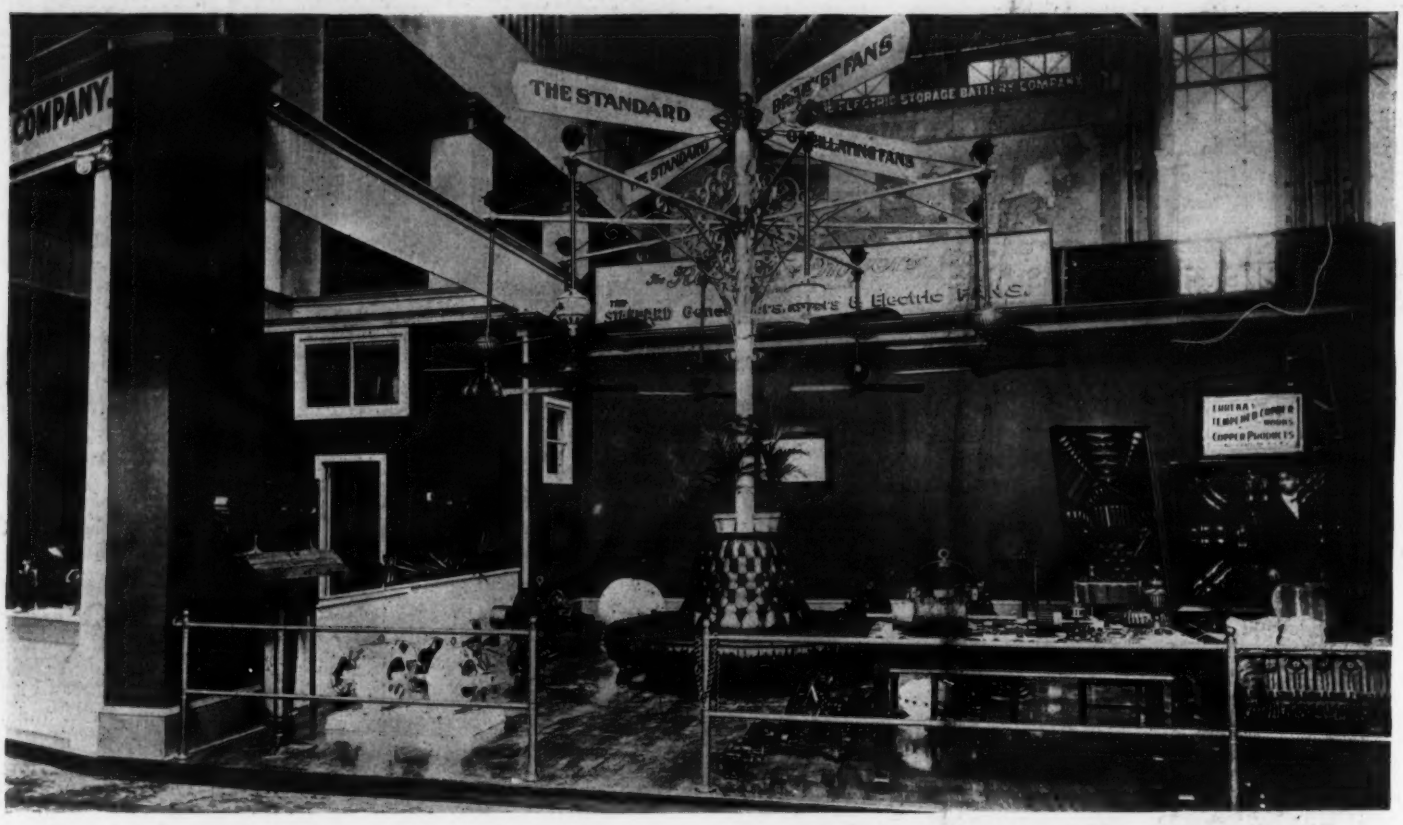


Fig. 4.—Exhibit of Robbins & Myers Co.

Fig. 5.—Hall's electroplating exhibit.

Fig. 6.—Triumph Electric Co.'s exhibit, as seen across the aisle.

these tool motors are designed for 220 volts. The inoperative machinery consists of a 100-kw multipolar engine type generator and a series of power motors ranging in size from ½ to 25 horse power. A large armature core is partially wound to illustrate the method and details of construction, also other detail parts of the various machines are shown.

More and more attention is given to better hygienic and sanitary

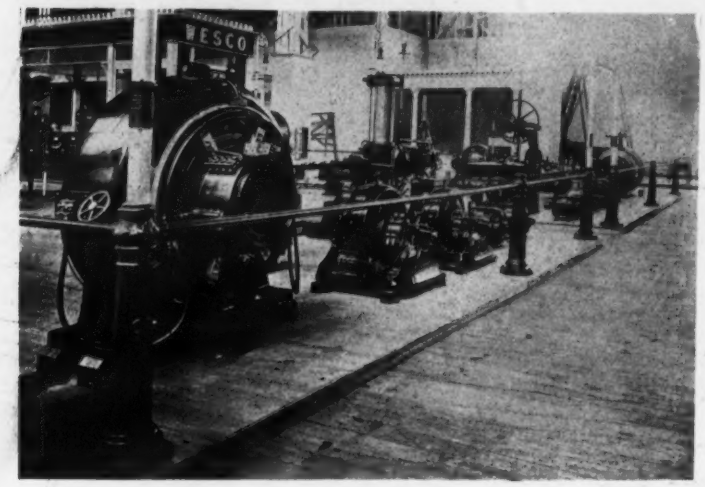


FIG. 7.—TRIUMPH ELECTRIC COMPANY'S EXHIBIT.

conditions wherever large numbers of people are brought in contact. It is claimed that one of the most fertile sources of disease transmission is the telephone transmitter, because it collects the bacteria from the breath of those speaking into the mouthpiece. The Telephone Hygenic Company's exhibit indicates how this can be obviated by stretching an antiseptic paper before the mouthpiece. The paper surface can be changed at any time by the speaker giving the roll a turn. This does not interfere with the transmission of sound, but rather magnifies the vibrations.

The Delany system of rapid telegraphy is demonstrated by a com-

FIG. 8.—HYGIENIC TELEPHONE EXHIBIT.

plete set of operating apparatus. The speed of transmission is as high as 1,000 words a minute and this is accomplished by the following means: A strip of paper passes through a perforator operated by a typewriter keyboard, and the depression of the key instead of printing the letter punches perforations on the tape corresponding to Morse characters. The perforated tape is then passed through the transmitter, and by means of contact through the perforations impulses of equal duration and alternating polarity are sent over the line. At the opposite end of the line, messages are recorded by an automatic receiver on a chemical tape. As the Morse dot and dash record is made, the tape is wound on reels and distributed to typewriters for transcription. Different modifications of parts of this apparatus are also shown in operation.

The exhibit of the Fort Wayne Electric Works is characterized by the life and light displayed. There are sixty arc lamps in and around

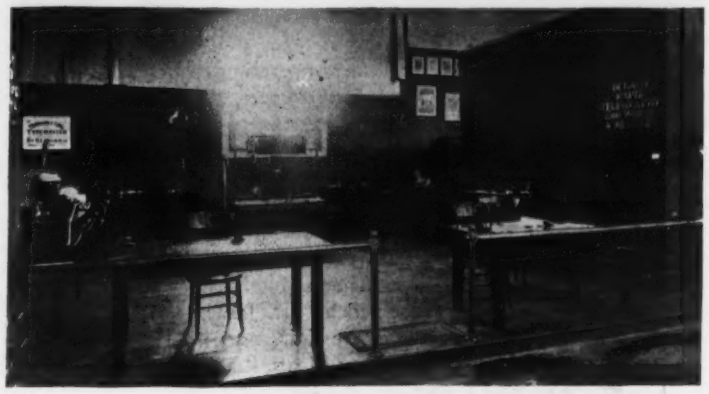


FIG. 9.—DELANY RAPID TELEGRAPH EXHIBIT.

the space, which make a most brilliant illumination. A handsome ten-panel switchboard is provided for distribution and regulation. From the building sub-station, two supplies of current are received, one a three-wire, 220-volt, direct-current, and the other 500-volt, direct-current. A series of motor generators convert this current for

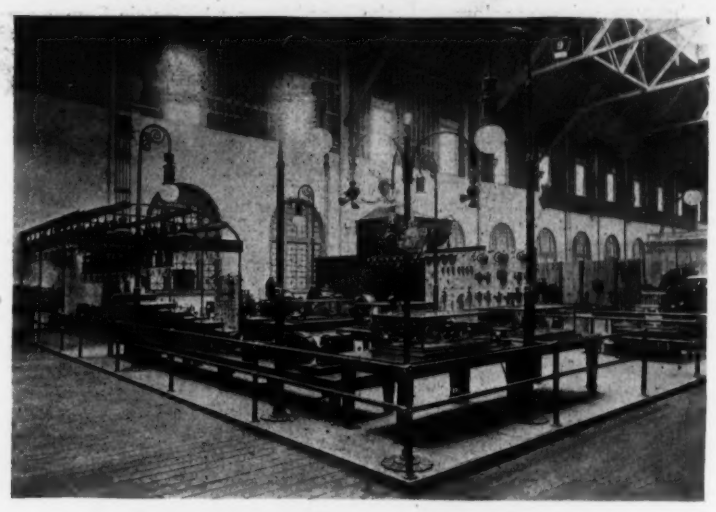


FIG. 10.—EXHIBIT OF FORT WAYNE ELECTRIC WORKS.

the different applications. The first is a 55-hp, 220-volt motor driving a 37½-kw, 1,100-volt alternator, which furnishes current to the series and multiple alternating current arc lamps. The next set consists of a 30-hp, 220-volt motor driving a Wood constant current,

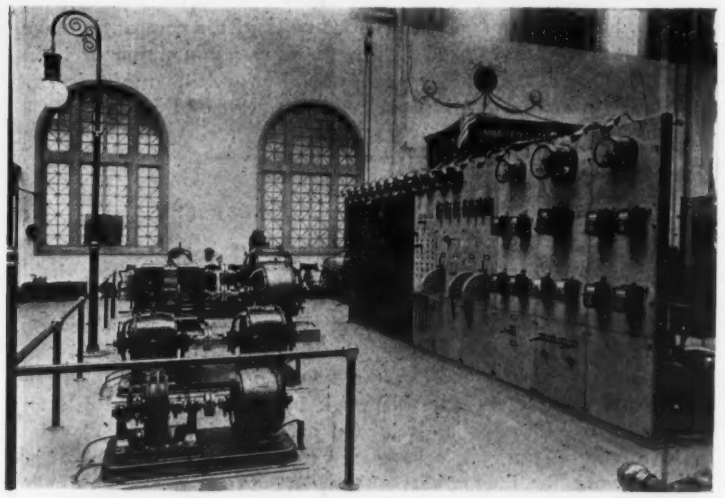


FIG. 11.—ANOTHER VIEW OF FORT WAYNE EXHIBIT.

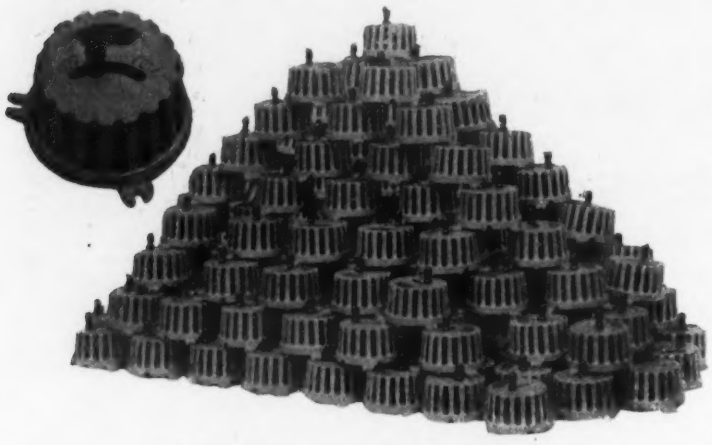
series arc, 6½-ampere dynamo of 22 light capacity. A 15-hp, 500-volt motor is direct connected to a two-phase 110-volt, 60-cycle generator which supplies current to the 20,000-volt transformer for operating the De Forest wireless telegraph stations already illustrated, one of

which occupies a small space in this exhibit. Another supply of alternating current is from a 140-cycle alternator driven at 2,800 r.p.m. by a 4-hp, 500-volt motor. A line of transformers from 1 to 50-kw is displayed, as well as windings and sections showing the thorough methods of insulation. The different types of wattmeters made by this company are displayed under operating conditions on the switchboard panels and in cases are mounted all the separate parts used in the construction of these instruments. The Fort Wayne series alternating arc lighting system, as described in ELECTRICAL WORLD AND ENGINEER of June 4, is complete and in operation.

The most popular part of the exhibit is at the corner of the two aisles, where a standard carries a number of Fort Wayne oscillating fan motors which distribute a refreshing breeze to all who stop and watch their gyrations. Perhaps the most interesting item in the space is the arc-light machine constructed by Mr. James J. Wood, in May, 1879. It will furnish power for arc light, and it was so well constructed that after a quarter century of use it is still serviceable.

Ceiling Fan Controller.

As there has been a very considerable demand both at home and abroad for a ceiling fan controller of sufficiently fine appearance to permit of its being mounted in finely furnished hotels, restaurants, clubrooms, private parlors, etc., the Ward Leonard Electric Company, of Bronxville, N. Y., has placed upon the market a small, highly finished rheostat, as shown in the accompanying cut. The company has sent some twelve hundred of these regulators abroad to one house,



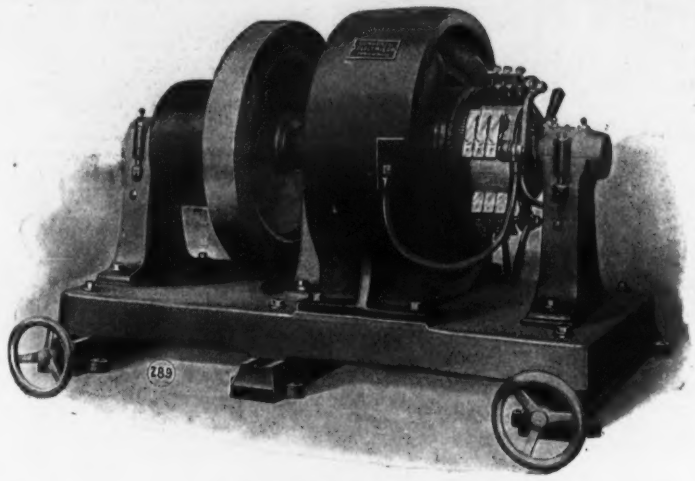
A PILE OF CEILING FAN CONTROLLERS.

Messrs. Geipel & Lange, of England. An interesting pile of them is shown in the illustration.

The resistance of this regulator consists of the well-known entirely enclosed, hermetically sealed resistance units of the company's make. These rheostats are finished in bronze, copper, aluminum or black japan finish, and make a very ornamental as well as useful instrument. The corner view shows a single rheostat of this type.

Generators for Gas Engine Plants.

In the early gas engine electric lighting work it was the habit to place all the blame for irregular running and for flickering light upon the prime motor, but the rapid improvements in this respect, of recent years, have been largely due to the design of special generators. We illustrate herewith a type, or line, of direct-current generators brought out for this work by the Commercial Electric Company, of Indianapolis, Ind. On account of the irregular impulses of the engines, it is necessary to provide a fly-wheel which will overcome the fluctuations of the dynamo speed and produce a steady light, which is impossible where the irregularities of the engine speed are reproduced in the armature of the dynamo. This requirement has sometimes been met by placing a heavy fly-wheel upon an extension of the armature shaft, without providing any additional support for this wheel. As standard dynamo bearings are generally not sufficiently heavy to sustain the extra weight of the fly-wheel, this method has generally given but slight satisfaction. In order to satisfactorily overcome these speed fluctuations without imposing unusual strains upon the dynamo parts, the Commercial company has designed special machines having an extra heavy shaft, which is extended to receive a heavy fly-wheel and which is supported by three bearings, two of which are placed close upon either side of the fly-wheel, where they will support its weight and receive the extra strain caused by the jerking of the



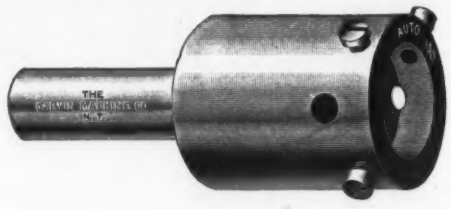
GENERATOR FOR GAS ENGINE.

dynamo belt without injurious effect upon the dynamo. These three pedestals, with the machine frame, are mounted upon a heavy iron base, which is carried upon sliding rails with hand wheels and thrust screws, by means of which the belt tension can be adjusted. Py this construction the overloading of the dynamo bearings or the expense of an extra countershaft for carrying the fly-wheel is avoided, and a substantial mechanical machine, capable of producing a steady light, is secured. These machines include all the usual sizes and speeds from ½ to 30 kw.

Automatic Die Holder.

The illustration shows a new automatic hollow shank die holder for screw machines. This die holder is specially designed by the Garvin Machine Company, of Spring and Varick Streets, New York City, for high speed and overcomes many of the defects which develop in these tools, when used under such conditions. It is clutched positively, going forward, but on reverse, when the die is in rapid rotation, and must be stopped, it is held by friction grip, so that it is noiseless in action and reverses without shock and clatter, which conduces greatly to increased durability and efficiency. The friction grip consists of three rollers each resting on a small incline and embraced by a steel shell, all these parts being hardened and of substantial size.

The hollow shank permits long work to pass clear through; but the working parts are protected from chips and grit. To prevent



AUTOMATIC DIE HOLDER.

hammering, when reversing, is more difficult with a hollow shank holder than with the solid shank construction; but in using this new style of holder there is no danger of engaging the reversing clutch too soon, and hammering is done away with.

The die reverses itself instantly and automatically, on throwing the shipper, and begins to run back of itself, and requires no cooperation in starting to move the turret slide backward at the right instant and can, therefore, be operated with less skill and experience on the part of the operator. The die holder is made in three sizes.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—A sharp rally early in the week imparted a little more firmness to the stock market, but there was a lack of speculative interest. United States Steel securities were firm despite unfavorable reports as to the iron trade and the postponement of action on the preferred dividend until the end of July. Little interest was shown in any of the industrials apart from the Steel securities, and the traction group was also neglected. At the close of the week the general market was broader and more active at advances. Brooklyn Rapid Transit, on a fair amount of trading, advanced from 46¾ to 48⅝, closing at 48⅜, this being an advance of 1⅜ points. Metropolitan Street Railway became active and strong, 16,760 shares having been sold at prices ranging from 109⅝ to 114, the closing quotation being 113⅞—a net gain of 3⅞ points. The telegraph and electric stocks, with the exception of Westinghouse, showed increased strength and advances. Allis-Chalmers closed at 8, being 1 point better than the closing figure of the previous week; General Electric rose from 155, the lowest, to 159½, the highest quotation of the week, and closed at 155, thus gaining 3 points net. Westinghouse lost ⅛ of a point, closing at 156. American Telephone & Telegraph fluctuated between 125½ and 128, the latter being the closing price, and an advance of 2¾ points as compared with the last previous quotation. Western Union closed 1⅜ better off, the last quotation being 87½. The curb market was stronger in tone and prices were higher, following the lead of the main market. The feature was the strength of Interborough Rapid Transit, which advanced nearly 3 points in connection with the declaration of the first dividend. Among the specialties a sharp advance in Electric Boat was ascribed to activity in submarine boat building for war purposes. Mackay Companies common made a sharp rise, no particular reason therefore being apparent, and Electric Vehicle seemed to be under manipulation. Following are the Stock Exchange closing quotations of June 14:

NEW YORK.

	June 7	June 14		June 7	June 14
Allis-Chalmers Co.	7⅛	7⅝	Electric Vehicle	7¾	8⅜
Allis-Chalmers Co. pfd	40	41	Electric Vehicle pfd	10¾	11
American Tel. & Cable	86	87	General Electric	155	158⅜
American Tel. & Tel	125	128¾	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	110⅝	114⅛
Brooklyn Rapid Transit	47	48⅜	N. Y. & N. J Tel.	..	..
Commercial Cable	180	175	Marconi Tel.	..	..
Electric Boat	25	30	Western Union Tel.	86¼	87
Electric Boat pfd.	66	64	Westinghouse com.	154	154
Electric Lead Reduction	*⅜	*⅜	Westinghouse pfd	180	180

BOSTON

	June 7	June 14		June 7	June 14
American Tel. & Tel.	125	128¾	Western Tel. & Tel. pfd.	77	80
Cumberland Telephone	112	112	Mexican Telephone	1¼	1¼
Edison Elec. Illum	*235	234¾	New England Telephone	118	120
General Electric	155	156	Mass. Elec. Ry	18¼	18¾
Western Tel. & Tel.	..	7⅛	Mass. Elec. Ry. pfd.	..	70

PHILADELPHIA.

	June 7	June 14		June 7	June 14
American Railways	43	43	Phila. Traction	96	..
Elec. Storage Battery	55	54	Phila. Electric	6⅜	6
Elec. Storage Battery pfd.	55	54	Phila. Rapid Trans.	12¼	12
Elec. Co. of America	8¼	8⅛			

CHICAGO

	June 7	June 14		June 7	June 14
Central Union Tel.	..	..	National Carbon pfd.	101	*102
Chicago Edison	144	..	Metropolitan Elev. com.	21	20½
Chicago City Ry.	170	175	Union Traction	*63¾	..
Chicago Tel. Co.	118	..	Union Traction pfd.	28	*30
National Carbon	26¼	26¼			

*Asked

ALLIS-CHALMERS ANNUAL REPORT.—The Allis-Chalmers Company issues its annual report for the year ended April 30, 1904. The income account compares as follows:

	1904.	1903.	1902.
Net profits	$952,624	$1,653,576	$1,442,259
Preferred Dividends	853,125	1,137,500	1,137,500
Surplus	$99,499	$516,076	$304,759
Previous surplus	820,835	304,759	.....
Total surplus	$920,334	$820,835	.....

Net profits are given after deducting operating expenses, reserve, depreciation, maintenance and repairs. To the surplus of $920,334 was added the sum of $201,951, which was the excess of par value over book cost of $100,000 preferred stock and $180,000 common stock acquired in settlement of current business contracts, etc. This makes a total of $1,122,286, from which special appropriations amounting to $497,450 have been deducted, leaving a net profit and loss surplus April 30, 1904, of $624,835. The general balance sheet as of April 30, 1904, compares as follows:

Assets:	1904.	1903.	1902.
Real estate, bldgs., plts., good will, etc.	$30,246,084	$29,199,493	$27,352,082
Bills and accounts received	3,437,520	2,475,579	2,778,721
Merchandise, materials, etc.	2,914,878	5,131,800	3,333,665
Cash	1,060,113	1,628,009	4,514,167
Bullock Electric Mfg. Company	463,000	.....	.....
Total	$38,121,596	$38,434,881	$37,978,635
Liabilities:			
Preferred stock	$16,150,000	$16,250,000	$16,250,000
Common stock	19,820,000	20,000,000	20,000,000
Accounts payable	1,014,396	1,079,671	1,139,500
Mortgage due March, 1905	34,000	.....	.....
Dividends payable May 1	.....	284,375	284,375
Depreciation reserves	478,365	.....	.....
Surplus	624,835	820,835	304,760
Total	$38,121,596	$38,434,881	$37,978,635

President B. H. Warren says: "The fiscal year will hereafter terminate on the last day of June in each year. In the settlement of several business contracts entered into prior to March 1st, the company became the owner of $100,000 par value of its preferred stock and $180,000 par value of its common stock, which shares have been cancelled, thus reducing the outstanding capital stock to $16,150,000 of preferred stock entitled to cumulative dividends, at the rate of 7 per cent. per annum, from February 1, 1904, and to $19,820,000 of common stock." During the past year the following expenditures have been made in the increase, or for greater economy in the operation, of the productive property of the company:

Additions to plants	$642,232
New plant	77,300
Terminal railroad	49,060
Capital expenditures during the year	$768,592
The cost of manufacture during the past year has included charges for:	
Maintenance and repairs	$752,535
Depreciation	244,478
An operating expense of	$997,013

The report also calls attention to the arrangements with other concerns, and the acquisition of plants, etc., in Canada. It adds: "All the property of the company is owned in fee except the Bullock Electrical Works at Norwood, near Cincinnati, Ohio, the latter being held under a long lease. The entire property is free from mortgage or other lien, with the single exception of that for $34,000 assumed in the purchase of the Norwood Foundry, and which, by its terms, cannot be retired until its maturity, March 22, 1905. No mortgage can be placed upon the property without the assent of 75 per cent. of the amount of preferred stock outstanding."

A UNIVERSITY'S INVESTMENTS.—It were well, says *Leslie's Weekly*, if every college, as a public institution, made a full statement of its financial affairs each year. Harvard College does make such a statement. It is interesting to know some of the forms of the investment of the funds of our oldest university. Railroad stocks and railroad bonds represent a favorite investment. A hundred thousand dollars in the Chicago & Alton 4 per cent. collateral notes; a hundred thousand dollars in the Chicago Northwestern Railroad general mortgage 3½ per cent. of 1987; two hundred thousand dollars of the Louisville & Jeffersonville Bridge Company first mortgage 4s of 1945; a hundred thousand of New York Central & Hudson River Railroad 3½s of 1988, and a hundred thousand dollars of Schenectady Railway first mortgage 4½s of 1941, are entries found in a single column. A score of the great steam railways of the country are represented in the list of securities. Many street railroads, too, as those of New York, Minneapolis and Massachusetts electric companies, are found in the list. The notes also of great manufacturing companies, such as the Manchester Cotton Mills and the Merrimac Manufacturing Company, are a favorite form of investment. Manufacturing and telephone stocks and real estate trust stocks are not absent. The total is about $3,000,000.

DIVIDENDS.—The United Railways Investment Company of San Francisco has declared a semi-annual dividend of 1¾ per cent. on the preferred stock, being an increase of ¼ per cent, payable July 1st. The Interborough Rapid Transit Company of New York has declared a dividend of 2 per cent. United Gas Improvement Company has declared a dividend of 2 per cent. for the quarter. The Seattle Electric Company has declared a semi-annual dividend of 3 per cent. on the preferred, payable October 7th. The directors of Commercial Cable have declared the regular quarterly dividend of 2 per cent., payable July 1st. In accordance with the pro-

visions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a semi-annual dividend rental of $2 per share will be paid on West End Street Railway preferred stock July 1st. The Strowger Automatic Telephone Company has declared the regular semi-annual dividend of 50 cents per share, payable July 1st. The directors of the Railway Equipment Company have declared the regular monthly dividend of 1½ per cent. and an extra dividend of 2 per cent., payable June 15th.

WESTERN UNION REPORT.—The Western Union Telegraph Company issued last week its annual statement for the year ending June 30th, together with a statement of the business for the quarter ending on the same date. The statements are partly estimated. The annual statement shows a net surplus of $1,908,914, as against $2,268,722 for last year and $1,431,718 for 1902. The company's total surplus is $14,928,638. The statement for the quarter shows a net surplus of $340,433, as against $504,383 for 1903, $420,697 for the same quarter in 1902, and $306,391 for the quarter in 1901. The detailed figures follow:

	1904. (estimated)	1903. (actual)	1902. (actual)	1901. (actual)
Net revenue	$1,850,000	$2,007,698	$1,892,476	$1,762,436
Bond interest	292,550	286,300	254,770	239,040
Balance	$1,557,450	$1.721,398	$1,637,706	$1,523,396
Dividends	1,217,017	1,217,015	1,217,009	1,217,005
Surplus	$340,433	$504,383	$420,697	$306,391
Previous surplus	14,588,205	12,513,341	10,330,306	9,012,894
Total surplus	$14,928,638	$13,019,724	$10,751,003	$9,319,285
Twelve months:				
Net revenue	$7,934,682	$8,214,472	$7,292,329	$6,685,249
Bond interest	1,157,700	1,077,700	992,580	956,160
Balance	$6,776,982	$7,136,772	$6,299,749	$5,729,089
Dividends	4,868,068	4,868,050	4,868,031	4,868,008
Surplus	$1,908,914	$2,268,722	$1,431,718	$861,081
Previous surplus	13,019,724	10,751,000	9,319,285	8,458,205
Total surplus	$14,928,638	$13,019,725	$10,751,003	$9,319,286

The figures are generally considered an excellent showing in view of trade conditions and the lopping off of poolroom business.

NEW YORK INTERBOROUGH.—The Interborough Rapid Transit Company's directors met last week and declared a dividend of 2 per cent. payable on July 1st. This is the first dividend the company has declared. It has an authorized issue of $35,000,000 stock, all or nearly all of which is outstanding. As the subway is not completed, the dividend must be paid out of the surplus of the Manhattan Elevated. The balance sheet of the Interborough Company of June 30, 1903, showed a surplus of $547,000. The Interborough operates the elevated lines under a lease which provides that the yearly rental shall be 6 per cent. on the stock up to and including January 1, 1906, and 1 per cent. additional if earned. After January 1, 1906, the rental is 7 per cent. The Manhattan's surplus for the six months ended December 31st last, after interest and rentals had been paid, amounted to $2,621,278, as compared with $1,765,760 for the corresponding six months of the previous year.

Commercial Intelligence.

THE WEEK IN TRADE.—The iron trade was reported very dull, and production is being curtailed, but stocks increased during May. The other metals were dull and somewhat weaker, the price of copper being reduced ¼c, which, however, did not increase the number of purchases. The closing prices were 12¾ @ 13c for Lake; 12⅝ @ 12⅞c for electrolytic and 12⅜ @ 12½c for casting. The London market is lower for both spot and futures. The exports so far this month aggregate 2,994 tons. *Bradstreet's* reports 171 business failures during the week ending June 9th, against 194 the week previous and 181 the corresponding week last year. The Lake strike is still exerting a detrimental influence in many lines along the northern border. Railway earnings show the effect of the smaller movement of business in May, the aggregate of which shows a decrease of 3.5 per cent. from a year ago. April net earnings indicate a decrease of 6 per cent. as compared with the same month last year, the anthracite coal roads being conspicuous exceptions. Trade and industry are quiet as a whole, and the money market still reflects speculative depression and a curtailment of demand for money in trade circles. There is an expansion of export trade in iron and steel, leather and lumber as a result of lower prices, but there is no improvement in the foreign demand for cereals. Rains, swollen streams and cool weather in various sections have had an unfavorable effect on crop development and on retail trade in seasonable goods. Prices of nearly all classes of staple products are on the downward turn as a result of the slack demand, but it is believed in many quarters that these lower prices are in themselves a good feature, and will induce buying that higher prices had choked off, people preferring to wait.

RAILROAD TIE PROBLEM.—The railroads and trolley lines will in a few years, according to the *Wall Street Journal,* be seriously confronted with the tie problem. This is known in an indefinite way, but the day has generally been thought to be remotely in the future. The eastern railroads for some time have been able to draw only a small part of their tie supply from their own territory. West Virginia for a long time was a great resource, but the tie-producing area has moved south. The great bulk of the ties now comes from the Carolinas and Georgia, whence they are brought north by coastwise sailing vessels. The growing scarcity is reflected in the figures below, which are the average price per tie paid each year by a large eastern road: 1898, 45 cents; 1899, 49 cents; 1900, 59 cents; 1901, 56 cents; 1902, 55 cents; 1903, 60 cents; 1904, 62 cents. The advanced methods in forestry which are gradually coming into vogue are arresting the reckless forest destruction in some quarters. But the results so far are feeble and not general. The solution of the problem by using a substitute for the wooden tie is often discussed. Metal ties have so far proved a failure in America because of the great weight of the rolling stock to be sustained. Under any conditions the steel tie will always be wanting in the resiliency which is so great a desideratum to both rolling stock and track. Should it be that the electric motor will in time supersede the freight locomotive with its ponderous reciprocating parts, some part of the objection to the steel tie may be removed. It is asserted that at no distant date, the demand for steel ties alone will be a big boom for the United States Steel Corporation. There have been suggestions of ties of fibrous artificial material, of toughened glass and of asphalt. The last named proposes the use of a block of wood under each rail base. Such a tie would have weight bearing surface, structural rigidity and resiliency and would seem to be promising. Some roads have already anticipated the trend of things and have established departments of forestry, and gone into the growing of their own ties. This plan commits the railroad to a large expenditure, but it is a wise one. However, it is believed very much could be done by a forestry bureau on each railroad whose territory offers any possibilities of trees growing, such bureau to cooperate with the farmers along the line stimulating forest culture by the many agencies of education and cooperation which the railroad has at its command. The prospect of tie shortage which is coming before the railroads is due to wanton and reckless waste rather than to inadequacy of resources. With better husbanding of resources great things can be done.

CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, through its New York City offices, of which F. B. De Gress is manager, reports recent receipts of numerous orders for generators, motors, etc., to be shipped to New York, New Jersey and Connecticut points. The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., has ordered four standard motors ranging in capacity from 15 hp to 25 hp. This is a repeat order. The New Haven (Conn.) Clock Company is to be shipped a 100-kw generator and two 50-hp motors. The J. B. Williams Co., of Glastonbury, Conn., has requisitioned for a 150-kw engine type generator. The Derby (Conn.) Gas Company has ordered two 10-hp and two 5-hp motors. The State Board of Education, Trenton, N. J., has placed an order for a 50-kw engine type generator and a 10-hp motor. The Capewell Horse Nail Company, of Hartford, Conn., is to be shipped additional Crocker-Wheeler equipment consisting of a 40-kw generator and a 25-hp motor; while six motors of various sizes have been ordered for installation in the bakery of Hicks & Schmidt, 587 Greenwich street, New York City. The New Jersey Zinc Company has called for two 25-hp standard motors for its Franklin, N. J., plant, and has also ordered three motors of the same capacity for installation in its Hazard, Pa., plant. The John A. Roebling's Sons Co., of Trenton, N. J., is to be shipped a 90-hp motor. Two 13-hp motors will be forwarded to the De La Mar Copper Works, at Carteret, N. J., while the Pittsburg Reduction Company has ordered 22 small motors to be utilized for driving fans at its Massena, N. Y., plant. Mr. De Gress states that the May orders secured in his territory show an increase of fully 50 per cent. over those taken in April, and represent the largest monthly sales so far this year.

A HUGE COPPER CONSOLIDATION.—The *New York World* says: "Announcement will soon be made of a combination of mining interests of America with John D. Rockefeller at its head. The capital of the merged companies, it is said, will be $2,500,000,000, and the purpose is to control the mineral output of the United States, with the possible exception of the Calument & Hecla copper mine of Michigan. Senator Clark's United Verde and Montana properties and those of F. A. Heinze in Montana are said to be included, as also are the principal mining companies of Colorado, Utah and California."

General News.

THE TELEPHONE.

GILLETT, ARK.—The People's Union Telephone Company has been incorporated with a capital stock of $25,000. William J. Stillwell is president.

JONESBORO, ARK.—The Automatic Home Telephone Company has been incorporated with a capital stock of $25,000. R. L. Collins is president.

SANTA ROSA, CAL.—The Westside Telephone of Healdsburg has been incorporated by J. McClish, M. V. Frost and others.

LOS ANGELES, CAL.—Articles of incorporation have been filed in the county clerk's office by the San Fernand Home Telephone Company, of which Charles F. Guthridge, Charles L. Zahm, Arthur Wright, D. F. Boyce and C. P. Platt, all of Los Angeles, are the first directors. The company is capitalized at $50,000, of which $10,000 has been subscribed.

FISHER, ILL.—The Granger Mutual Telephone Company has reduced its capital from $15,000 to $10,000.

NUNDA, ILL.—The Union Light & Telephone Company has increased its capital stock from $15,000 to $25,000.

INDIANAPOLIS, IND.—The Central Union Telephone Company has issued a new order reducing toll rates in Indiana, Ohio and Illinois. New toll lines have been built and the company is now able to handle more business and give lower rates.

EVANSVILLE, IND.—The members of the common council have decided to postpone action on the telephone question. It is generally believed that the Citizens Telephone Company is desirous of giving way to the Home Telephone Company.

MUNCIE, IND.—The Madison & Delaware County Telephone Company is preparing to make extensive improvements in its exchange and lines in this locality. Manager Bromley announces that he will be in the market for a large amount of material for the contemplated work.

CRAWFORDSVILLE, IND.—The Central Union Telephone Company is making an effort to put in a new telephone system in this city. The business men oppose it and insist that there is not room for two systems here. The Central Union maintains a toll station here.

KELLERTON, IA.—The Kellerton Telephone Company will build a line to Mt. Ayr.

WEBSTER CITY, IA.—The Martin Telephone Company has ordered two additional sections for its switchboard.

CEDAR FALLS, IA.—The Cedar Falls Mutual Telephone Company has been incorporated with a capital stock of $25,000, by N. H. Norris and others.

SPEARVILLE, KAN.—The Spearville Telephone Company has been incorporated with a capital stock of $2000.

BANGOR, ME.—The petition of the Automatic Telephone Company to enter Bangor with its lines was voted down at a special meeting of the Board of Aldermen.

CHIHUAHUA, MEX.—Governor Luis Terrazas, of the State of Chihuahua, has granted a concession for the construction and operation of a telephone line from Las Cuevas to Roncesvalles and from Morris to Socorro and other points in the State.

CITY OF MEXICO, MEX.—The Mexican Government and the city council of the City of Mexico have extended for a further period of six months the concession held by Jose Sitzenstaller for the construction of a telephone system in the City of Mexico. Under the terms of the extension the work of construction must be commenced within six months from May 4 of the present year. It is stated that Mr. Sitzenstaller is making an effort to organize a strong company to finance and carry out the proposed enterprise. It is his intention to install a complete system which will be a strong competitor of the system of the Mexican Telephone Company now in operation here.

PLYMOUTH, MICH.—A new telephone company has been formed here by J. J. Sherer, J. C. Brayton and others.

HANCOCK, MICH.—The Michigan Telephone Company will expend $50,000 in improvements to its system in this section.

ANN ARBOR, MICH.—It looks as if there was a movement on foot to consolidate the independent telephone companies of Michigan, and unite the system with those already developed in other states. The Washtenaw Home Telephone Company has already spent $25,000 or $30,000 in Ann Arbor and vicinity and is about ready to begin business.

BAY CITY, MICH.—The Michigan State Telephone Company will build trunk lines on 1000 miles of the Pere Marquette Railroad's right of way, having closed a deal with the railroad company for that privilege. By the end of the year the company will have about 70,000 subscribers, an increase of over 15,000. Rights have also been secured for trunk lines on the South Shore Road's right of way in the upper peninsula.

ST. PAUL, MINN.—The Shakopee Telephone Company has increased its capital from $3000 to $10,000.

DASSELL, MINN.—The Dassell-Collinwood Telephone Exchange Company has been incorporated with a capital stock of $25,000. The directors are S. N. Gayner, S. Oyster and others.

WATERTOWN, MINN.—The Watertown Telephone Company has been incorporated with a capital stock of $25,000. F. A. Barth is president.

ST. PETER, MINN.—At the annual meeting of the Nicollet County Telephone Company, officers were elected as follows: M. P. Quist, president; Charles Samuelson, vice-president; C. C. Nelson, secretary and manager, and P. A. Retrum, treasurer. The company was organized in 1898. The prime movers were farmers, and to-day they own the bulk of the stock, of which $19,650 is paid up. The lines cover over 150 miles of territory, distributed over Nicollet and Sibley Counties. The system has 322 telephones in operation, of which 182 are in the homes of farmers. The company also owns and operates exchanges at Gaylord, Gibbon, Lafayette and Norseland. Many improvements and extensions are in contemplation. The value of the system is placed at over $25,000.

NATCHEZ, MISS.—A long-distance telephone line will be constructed between Natchez, Miss., and Jonesville, La., by the Cumberland Telephone & Telegraph Company.

ST. LOUIS, MO.—A mortgage securing $5,000,000 in bonds of the Kinloch Long Distance Telephone Company of Missouri has been filed for record at Clayton, the county seat of St. Louis County, and copies will be placed on record in thirty-four other counties where the company owns property. The American Trust and Savings Bank, of Chicago, and Geo. W. Galbreath, of St. Louis, are named co-trustees. The bonds are 5 per cent. twenty-five-year gold and are given to pay off the indebtedness of the company and for improvements.

FORESTVILLE, N. Y.—The Conewango Valley Home Telephone Company has been incorporated with a capital stock of $11,000. The directors are A. H. Libbey, B. C. Wilson and others.

SENECA FALLS, N. Y.—A local telephone company has been organized in Fayette and the following-named gentlemen have been elected officers: President, Dr. McWayne; secretary, Fred Emens; treasurer, Charles O'Connor.

CATSKILL, N. Y.—A telephone war is on. The Hudson River Company in 1884 purchased the wires and poles of the Catskill Telephone Exchange, and for years has enjoyed a monopoly of business. Two years ago the West Shore Telephone Company secured a franchise to erect poles and string wires in the village of Catskill. The Hudson River Company has obstructed the West Shore in several ways, but the work has gone on. Last week the Hudson River Company erected a large pole on Grand View Avenue, but neglected to put on crossarms. During the night the West Shore Company strung wires which obstruct the setting of the crossarms. The manager of the Hudson River Company served notice on the West Shore that it would cut the wires. The latter called on the Sheriff of Greene County to protect the lines. It is said that the Hudson River Company never had a franchise to erect its poles. At last reports the conditions were still strained.

PHILLIPSBURG, OHIO.—The Acme Telephone Company, with a capital stock of $15,000, has been incorporated.

ROCKFORD, OHIO.—The Rockford Toll Line Telephone Company has increased its capital from $10,000 to $20,000.

FINDLAY, OHIO.—The Mt. Cory Farmers' Mutual Telephone Company has been organized with W. A. Williamson as president.

ROCKFORD, OHIO.—The Rockford Toll Line Telephone Company has increased its capital stock from $8000 to $20,000 and will make improvements.

BAINBRIDGE, OHIO.—The Bainbridge Telephone Company has been incorporated with a capital stock of $10,000. The directors are O. E. Post, C. S. Leinhart and others.

CLEVELAND, OHIO.—The Bell Telephone Company is stringing two new long distance lines between Cleveland and Columbus, two between Cleveland and New Castle, Pa., and two between Cleveland and Buffalo. Extensive improvements are being made on the Cleveland long distance switchboard.

YORK, PA.—The York Telephone Company has declared its usual semi-annual dividend of 2 per cent. payable July 1.

DOYLESTOWN, PA.—Application has been made for a charter for an independent telephone line to be operated in the upper end of the county under the name of the Franklin Telegraph & Telephone Company. Those interested are H. S. Funk, H. F. Funk, W. F. Witte, T. M. Moyer, N. S. Rice, J. J. Ott, C. B. Weaver and W. O. Ealer.

MANILA, P. I.—A telephone franchise has been applied for by the Sociedad de los Telefonos de Manila. The company will be under American management.

CHARLESTON, S. C.—The Island Telephone Company's entire outfit was sold at auction at Charleston recently for $8200, by Geo. E. Gibbon, said to be representing stockholders of the company. The system, with its numerous connections, may be operated again shortly. Foreclosure of deed of trust was the cause of the sale.

NASHVILLE, TENN.—The Gass Bridge Telephone Company, of Greene County, Tenn., has been chartered with $300 capital. W. S. Babb is interested.

CHATTANOOGA, TENN.—It is announced that the Southern Bell Telephone Company will build a long distance line from Chattanooga to Gadsden, Ala., at a cost of $50,000.

DENISON, TEX.—The Grayson County Telephone Company will spend $50,000 in improving its lines.

BROWNWOOD, TEX.—The Central Texas Telephone Company has applied to the city council of Brownwood for a franchise.

HONEY GROVE, TEX.—A. L. Hill, formerly manager of the telephone company at Smithville, Tex., will install a telephone system at Honey Grove.

SCHULENBURG, TEX.—The Schulenburg Telephone Company has been organized here with a capital stock of $5000. William E. Pertitz is one of the incorporators.

DEXTER, TEX.—The Dexter & Gainesville Telephone Company will install a telephone system in this section. The company was recently organized with principal office at Dexter. J. F. Morris, of Gainesville, is one of the incorporators.

WESTBY, WIS.—The Westby Telephone Company has increased its capital to $10,000.

LENA, WIS.—The Farmers & Merchants' Telephone Company has been incorporated with a capital stock of $4000.

ELECTRIC LIGHT AND POWER.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company, of Pine Bluff, contemplates the installation of another alternator of 250 or 300-kw capacity.

BRINKLEY, ARK.—The Farrell Light, Heat & Water Company of this place contemplates the building of a new plant. Mr. J. J. Farrell is the purchasing agent.

FAYETTEVILLE, ARK.—F. W. Fratt, Oklahoma City, Okla. Ter., states that it is proposed to install a new unit of from 120 to 150-kw, a two-phase alternator and an engine. J. W. McLendon, Fayetteville, superintendent, can give further information.

SPRINGVILLE, CAL.—C. L. Witten, of San Jose, is attorney for the Globe Light & Power Company, which intends to construct a power plant.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company, which made a bid of $400,000 for lighting the streets and public buildings for the year ending June 30, 1905, has signified its willingness to accept the figure of $320,000 allowed by the city budget. As the rival gas companies were absorbed last year, this company had no competitor in bidding for the street lighting. The bid for each electric arc lamp per night was 35 5-7 cents; number of lamps not to exceed 1111. The city is to be lighted every night in the year instead of according to the former moonlight schedule. The bid for lighting at the City Hall, Hall of Justice, etc., was 5 cents per kilowatt-hour, or $1 per thousand feet for gas. It was specified that not more than 4885 gas lamps be used. Last year, under competition, the rates were scaled down to fit an appropriation of $300,000, out of which the San Francisco Gas & Electric Company received $296,000.

SAN FRANCISCO, CAL.—The Shasta Power Company, H. L. Shannon, president, will put in the flumes and ditches and erect its 25-mile transmission line from a point on Bear Creek to Redding this fall. The first 1500-kw, three-phase Bullock generator, ordered through the Wagner-Bullock Electric Company, is expected to arrive next April, enabling the plant to be operated next summer. The power water will be diverted from Hat Creek, near Mt. Lassen, and conducted to Bear Creek, where there is a drop of 1500 in 6000 feet of pipe line. This company was recently incorporated by H. L. Shannon, T. I. O'Brien and F. Kingsbury, all of San Francisco, John W. Potts and Charles Jacobs, of Redding. The capital stock is $1,000,000 and money is available to install a plant costing $100,000. This project was erroneously reported last week as being that of the Mt. Lassen Water Power Company. The latter company proposes to install an electric transmission plant on Battle Creek, 35 miles from Redding. The company has been incorporated with a capital stock of $500,000, by C. H. Hilbert and A. Barnard, of Redding; L. M. Robbins, A. G. Sheath, M. A. Kenney and A. E. Bennett, of San Francisco.

BRISTOL, CONN.—The Wallace Barnes Company, Bristol, Conn., is building a new power house 40x60 feet, to be equipped with a 150-hp Cooper-Corliss engine which will operate a 150-kw General Electric generator. Two 100-hp Dillon boilers will furnish steam power.

WASHINGTON, D. C.—Bids will be received June 28 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of flexible conduit, rubber-covered conductor, electrical supplies, etc. Address H. T. B. Harris, Paymaster General.

BRAIDENTOWN, FLA.—The Manatee Light & Traction Company will install a series alternating arc system in this place.

CARROLLTON, GA.—It was voted June 4 to issue $45,000 bonds for water works, a sewerage system and an electric light plant.

ATHENS, GA.—The City of Athens is contemplating the enlargement of the municipal electric light plant. The present plant does not supply power enough for recent and contemplated extensions.

BARNESVILLE, GA.—G. E. Strickland and J. W. Strickland, of Pike, and associates, are applying for a charter for the Flint River Power Company. The property to be developed by the company is the Flat Shoals on Flint River, from which 5000 hp may be obtained.

ATLANTA, GA.—The development of the immense water power at Bull Sluice Shoals, near Atlanta, has developed to the point where the water has been turned into the new electric power dam. It was thought that nearly a week would be required to fill the dam.

ALBANY, GA.—The town of Albany on June 9 voted on the question of a contract with the Albany Power & Manufacturing Company for supplying 300 electric horse-power annually for 17 years at $8000 each year. The company has also bought a water power near Albany which will probably be developed.

BOISE CITY, IDA.—The Highland Power Company's dam, located 20 miles up the river from Boise, was swept away by a recent flood. The power house was also badly damaged.

ROCKFORD, ILL.—It is stated that the Central Heat & Power Company will install a new electric plant this summer.

QUINCY, ILL.—The Independent Light & Power Company will increase the capacity of its plant by adding another unit consisting of a 1200-hp engine and a generator.

ELKHART, IND.—The Elkhart City Electric Company has incorporated with a capital stock of $15,000. C. G. Conn heads the board of directors.

DECATUR, IND.—The Decatur city lighting plant is to be enlarged by the addition of another Corliss engine of about 300 horse-power.

IOWA CITY, IA.—It is stated that the J. F. Hill Electric Company will install an electric light plant.

NEW ORLEANS, LA.—It is stated that the Consumers' Electric Company has purchased a site on Rampart and Bienville Streets for a power plant.

VIDALIA, LA.—The electric light plant which has been operated here by a New Orleans firm has been turned over to the municipality for $15,000, bonds for this amount having been voted last year. The plant cost $10,000.

BANGOR, ME.—The Underwriters' Light, Heat & Power Company, of Bangor, with $3,000,000 capital, has been incorporated under the laws of Maine.

TURNERS FALLS, MASS.—At a recent annual meeting of the Turners Falls Company is was voted to increase the capital from $300,000 to $600,000 and continue the work of improving the power and building an electric plant. C. T. Crocker is president.

MARSHALL, MICH.—The old Brush arc machines in the municipal lighting plant in this place will probably be taken out this summer, and the service changed over to the series alternating system. Mr. P. S. Joy is superintendent.

PENTWATER, MICH.—A contract has been entered into between the village and the Oceana Electric Company by which the company will install equipment to furnish 20 arc lights for the village and current for all private consumers at 50 cents per incandescent 32-cp lamp. Arc lights are to be of 1000-cp, and to cost $75 each per month for the 20 lamps.

WHITE BEAR, MINN.—The White Bear Electric Company has increased its capital stock from $10,000 to $25,000.

ROCHESTER, MINN.—A company may be organized to develop electric power from the water power at Jarrett. F. G. Colburn is owner.

MONTEVIDEO, MINN.—It is stated that the Montevideo Electric Light & Power Company will push the work of developing Minnesota Falls.

LAKE CITY, MINN.—A new engine and dynamo are to be installed in the municipal lighting plant, and the system is to be changed to the alternating.

EDINA, MO.—The Edina Electric Light & Power Company has been sold to P. M. Peterson, of Rock Springs, Wyo., through the agency of the J. S. Maurer Company. Mr. Peterson expects to remodel this plant and will therefore be in the market for general electrical supplies.

DELTA, MISS.—The Delta Electric Light & Power Company announces that it will immediately begin the work of extending its electric railway to take in all parts of the city. The rails, etc., have already arrived.

LINCOLN, NEB.—Electric light bonds to the amount of $65,000 have been sold.

CLINTON, N. Y.—A municipal lighting plant may be established here. The matter is being considered.

LOCKPORT, N. Y.—A contract has been entered into with the Lockport Gas & Electric Light Company for lighting the city for three years, beginning June 8, at $75 each for 300 arc lights.

MT. OLIVE, N. C.—Plans and estimates are being prepared for an electric light plant.

WEST MANSFIELD, OHIO.—The village of West Mansfield has sold $11,000 worth of bonds for the purpose of installing an electric light plant in the village. Contracts will be placed in the near future.

WARREN, OHIO.—Stockholders of the Warren Electric Light & Power Company are arranging to consolidate the company with the Warren Water Company. The company will be known as the Warren Water & Light Company.

TARENTUM, PA.—The citizens have voted to issue $37,000 bonds for improvements to the lighting plant.

SHENANDOAH, PA.—The Shenandoah & Mahanoy City Light, Heat & Power Company has been incorporated, with a capital of $75,000. David Graham, of Mahanoy City, is president, and W. T. Lee, of Shenandoah, is treasurer.

WILLIAMSPORT, PA.—It is stated that the Citizens Electric Light Company, of this place, of which Mr. Jonas Fischer is the principal owner, contemplates the erection of large buildings on the river-front for manufacturing purposes, and the utilization of water power for the generation of electric power for lighting, etc. Mr. Fischer's idea is to furnish commercial lighting, but he will also bid for the city lighting.

NEWBERRY, S. C.—The question of improving the electric light plant at a cost of $5000 is under consideration by the Town Council.

COLUMBIA, TENN.—The Columbia Water & Light Company will add new equipment for supplying a day service.

TRACY CITY, TENN.—The Tracy City Electric Light & Power Company has been incorporated, with a capital of $5000, by Samuel and Henry Werner.

COLUMBUS, TEX.—An effort is being made towards the establishment of an electric power plant on the Colorado River at this place.

LEONARD, TEX.—The Electric Light & Power Company has been organized at Leonard with a capital stock of $15,000. W. C. Evans is one of the incorporators of the company.

SHERMAN, TEX.—The Sherman Gas & Electric Company has been organized at Sherman with a capital stock of $200,000. The incorporators of the company are J. F. Strickland, W. R. Brents and C. N. Roberts, of Sherman; R. B. Sticher, of Cleburne; Osie Goodwin, M. B. Templeton and J. L. Penn, of Waxahachie, Tex.

RICHMOND, VA.—It is said that the Chesapeake & Ohio Railroad will investigate the matter of establishing an electric plant at Richmond for the purpose of supplying light and power for its buildings in the city.

SNOHOMISH, WASH.—The plant of the Electric Light & Power Company was destroyed by fire May 26. The loss was about $6000.

WHEELING, W. VA.—The Mutual Electric & Machine Company contemplates the erection of a $100,000 factory at Glenova for the manufacture of electrical machinery and apparatus. Mr. H. S. Sands is president.

GUAYAMA, PORTO RICO.—Bids will be received June 18 by Fernando Lugo Vina, Mayor, for $140,000 bonds to be used for an electric light plant, reservoir mains, sewerage system paving, erecting city hall, market-house, and for other public work.

THE ELECTRIC RAILWAY.

BUENA VISTA, CAL.—The city has granted to the American Crude Rubber Company, of which F. R. Marsh is president, a franchise to build an electric railway through the city to the various hot springs and summer resorts, not only for the purpose of carrying passengers, but also for carrying ore.

FORT COLLINS, COL.—The City Council has approved the ordinance granting electric street railway franchises to the Northern Colorado Electric Railway Company.

CHICAGO, ILL.—A special meeting of the stockholders of the South Side Elevated has been called for August 9, to authorize an issue of $8,000,000 4½ per cent bonds.

VEEDERSBURG, IND.—The survey is now being made for the proposed Veedersburg & Rockville Electric Railway.

INDIANAPOLIS, IND.—The Fidelity Construction Company, of Detroit, has commenced work near Noblesville, 25 miles from this city, on the construction of the Fort Wayne & Southeastern Railroad.

NEW CASTLE, IND.—Michael Gleason, of Richmond, reports that New York capitalists have consented to finance the Richmond & Northwestern Traction Company, in which he is interested. The line will run from New Castle to Richmond by way of Hagerstown.

MONTPELIER, IND.—The Portland, Montpelier, Warren & Huntington Electric Railway Company has filed articles of incorporation with the Secretary of State. The initial capital stock is $15,000. The directors are James West, Levi Hoffman and Scott Mills. The principal office will be in Montpelier.

FT. WAYNE, IND.—A syndicate of Eastern capitalists, headed by Thomas Wanamaker, of Philadelphia, has purchased the Fort Wayne Electric Light & Power Company's plant, and also the Fort Wayne traction lines and the bulk of the interurban connections which have recently been merged under the name of the Fort Wayne & Wabash Valley Traction Company.

ANGOLA, IND.—The stockholders of the Jackson & Fort Wayne Interurban Railway Company held a meeting here a few days ago and passed a resolution declaring that the road be built, equipped and operated at the earliest possible date, and authorized the directors to issue bonds to the amount of $4,000,000 for that purpose. John H. Roberts is president, and Joseph McKee, secretary.

OSKALOOSA, IA.—The Mahaska Construction Company has been formed to build an electric railway to Beacon and Buxton.

CRESTON, IA.—A company has been formed to build an electric interurban railway to Des Moines. Richard Brown, of Creston, is secretary.

NEW ORLEANS, LA.—The suit of the State of Louisiana against the New Orleans Railways Company involving the validity of the amalgamation of several street railway lines into one system has been reset for trial Nov. 7, at the request of the attorneys for the railways company.

SAGINAW, MICH.—T. E. Tarsney and T. G. Sullivan have asked for a receiver for the Detroit, Flint & Saginaw Railway, the newly projected interurban road from this city, which got as far as Bridgeport, 7 miles distant.

BELLEVILLE, MICH.—Citizens of this place and vicinity held recently a meeting to consider the project of building an electric railway from Detroit to Adrian, passing through this place. George William Moore, of Detroit, was present and addressed the meeting. An executive committee of seven was appointed. The proposed road is to be built on private right of way.

ROCHESTER, N. Y.—The Rochester & Eastern Rapid Railway Company has filed with the Secretary of State a certificate of increase of capital from $500,000 to $1,500,000.

NEW YORK, N. Y.—The Railroad Commissioners are said to have directed the Interborough Rapid Transit Company to equip all of its cars with fire extinguishers placed so as to be accessible in case of accident.

ROSLYN, N. Y.—Representatives of the Central Long Island Electric Light & Railroad Company are busily engaged in getting consents of property owners along the line of the proposed route of the company, between Huntington and Roslyn. All contracts have been signed for the construction of the line.

CHARLOTTE, N. C.—The new Jim Crow car law of Mississippi went into effect June 1, providing separate compartments in street cars for the races.

CARROLLTON, OHIO.—A. H. Snively is obtaining right of way through this district for a proposed electric railway from Canton to Steubenville.

CONNEAUT, OHIO.—George J. Chapman, chief promoter of the proposed Conneaut & Southern Railway, claims that Eastern capitalists will finance the project and that the prospects are good for the early commencement of construction work.

ZANESVILLE, OHIO.—The Southeastern Ohio Railway, Light & Power Company is advertising for bids for the construction of the roadbed of its line from South Zanesville to Crooksville; bids to be opened July 2. M. W. Hissey is president of the company.

XENIA, OHIO.—It is reported on good authority that the American Railways Company, which owns one of the local lines in Dayton, has secured control of the Dayton & Xenia Traction Company, which operates two distinct lines between Dayton and Xenia and a spur line to Spring Valley. It is stated that the Xenia line will be extended to Washington C. H., and the Spring Valley line to Wilmington.

NORWALK, OHIO.—The Sandusky, Norwalk & Mansfield Electric Railway Company has increased its capital stock to $600,000. Officers have been elected as follows: S. S. Burtsfield, of Toledo, president; Sherman Culp, of Norwalk, vice-president; B. B. Avery, of Cleveland, secretary-treasurer. The company has succeeded in financing its project for a line from Norwalk to Mansfield. C. F. Gilbert, of Cleveland, will be chief engineer in charge of construction work.

ST. CATHARINES, ONT.—The rate payers are to vote on June 22 on a by-law to approve the subscription of $20,000 worth of stock in Niagara, Queenston & St. Catharines Railway Company, which will build an electric railway from St. Catharines to Niagara-on-the-Lake and thence along the banks of the Niagara River to Queenston. W. A. Mittleberger is secretary-treasurer.

PORTLAND, ORE.—The Portland & St. Johns Railway Company has received a franchise to extend its line to St. Johns.

LEBANON, PA.—The Philadelphia, Lancaster & Harrisburg Passenger Railway Company has decided to extend its lines to Lebanon.

WEST BETHLEHEM, PA.—The Town Council has passed the ordinance granting a franchise to the Hanover Central Electric Railway Company.

LEBANON, PA.—Philadelphia capitalists, headed by Chas. S. Lurch, will build the proposed Palmyra, Valley Glen & Grantville Electric Railway this summer. A power house will be built at Valley Glen Park, which will be fitted up as a summer resort.

WEST CHESTER, PA.—The charter for the Oxford, Cochranville & Parkesburg Electric Railway has been filed. The entire distance covered is about 14 miles. Thomas E. O'Connell, of West Chester, is the principal promoter of the enterprise. The capital is given at $84,000.

HOUSTON, TEX.—The street car employes of the Houston Electric Company went on strike June 2.

SAN ANTONIO, TEX.—The shareholders of the Southern Light & Traction Company voted on June 2 to reduce the capital stock from $2,500,000, par of shares $100, to $2,500 par of shares 10 cents. The entire stock is owned by the American Light & Traction Company.

McKINNEY, TEX.—The survey for the proposed interurban electric railway between this place and Bonham by way of Blue Ridge and Denton has been commenced. It is stated that most of the right of way of the proposed line has been secured. R. Woodson, of St. Louis, Mo., is associated with local capitalists in the promotion of the enterprise. Jesse Shain, of McKinney, who is interested, can give information.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL CONSTRUCTION COMPANY, of San Diego, Cal., has been incorporated to manufacture and deal in electric and gas fixtures. The capitalization is $10,000.

THE PENN ELECTRIC EQUIPMENT COMPANY, of Camden, N. J., has been incorporated by B. L. Cater, G. C. Rawson and W. C. Rawson, the capital stock being $20,000.

THE NATIONAL BATTERY COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $500,000, the incorporators being R. L. Coleman, W. H. Miller and W. L. Hodges, of New York.

THE GENERAL RAILWAY SIGNAL COMPANY, of Gates, Monroe County, N. Y., has been incorporated with the Secretary of State, with a capital of $5,000,000, of which $2,000,000 is 6% cumulative preferred stock. The directors include Fredk. Cook, of Rochester, Geo. D. Morgan, of Buffalo, and other western New Yorkers.

LEGAL.

RIGHT TO OCCUPY TURNPIKE.—In an appeal by Brown vs. Radnor Township Electric Light Company, the Supreme Court of Pennsylvania has sustained the lower court as follows: 1. Under Act May 8, 1889 (P. L. 136), providing for the incorporation of electric light companies, and section 2, authorizing such corporations to supply light, heat and power to the public in the borough, town, city, or district where it may be located, such a company is not restricted by the word "district" to a division of a city or borough, but may be incorporated in a township. 2. Under Act May 8, 1889 (P. L. 136), providing that every electric light company shall have power to erect the necessary buildings and apparatus, with a right to enter upon any public street, lane, alley, or highway to inspect, alter, and repair its system of distribution, an electric light company has power to enter upon the bed of a turnpike road and erect its poles and string its wires, notwithstanding the objection of abutting owners owning the fee in the bed of the road.

SALE OF ELECTRICAL APPARATUS.—An appeal before the Court of Appeals of New York, settled in favor of the General Electric Company against the National Contracting Company, is of interest, as to sale of apparatus. The decision is summed up as follows: 1. A written contract of sale may be modified as to time of performance by consent of the parties, notwithstanding the contract provides that no modification thereof shall be binding unless in writing. 2. Where a written contract of sale, providing that no modification thereof should be binding unless in writing, was, by consent of the parties, and for their convenience, modified as to the time of performance, and defendant permitted plaintiff to go on with the work after the time specified in the contract, he is stopped from setting up the defense of nonperformance as to time. 3. An exception by defendant to certain testimony admitted in proceedings before a referee before the pleadings were amended is not available on appeal where the amendment obviated all objection to the testimony. 4. The seller of machinery to be delivered and installed at a specified time may, on refusal of the purchaser to accept or pay for the same, sell it at

public auction, and recover from the original purchaser the price thereof, after deducting the amount received at the auction sale and the cost of installing the machinery, together with interest on such balance from the time of the purchaser's default. The apparatus referred to was for the Hudson River Water Power Company at Spier Falls.

CONTROVERSY AS TO SUBWAY.—The Court of Appeals of the State of New York has decided in the suit of the Western Union Telegraph Co. vs. Electric Light & Power Co. of Syracuse, as to relative subway rights. The original telegraph subway was 16 in. high and 9 in. wide, a few feet below the street surface, with six wooden ducts. The electric light subway, under a later franchise, was 26 in. wide by 17 in. high in close juxtaposition to the other. The Appeals Court held: 1. Where plaintiff sued to restrain defendant from maintaining a street subway in close proximity to plaintiff's subway, previously constructed, and to compel defendant to remove its lines therefrom, but did not allege in its complaint that defendant was insolvent or that a multiplicity of suits would result, a judgment denying the injunction, but directing that defendant should indemnify plaintiff for any injuries it might suffer through the trespass by the execution of a bond, was erroneous, as an adjudication that an action in equity was unnecessary, as plaintiff had a sufficient remedy at law. 2. Where the common council of a city granted a corporation a right to construct a subway below the surface of the street, and provided that such franchise should not be deemed to give such company any exclusive right to the street for such subway, and reserved to the city all rights not specifically given, such company cannot object because the city thereafter gave another company a right to locate its subway so close to plaintiff's subway as to cause expense in making repairs, if such subsequent location was not an unreasonable interference with plaintiff's rights.

RIVAL LIGHTING COMPANIES.—The Supreme Court of Kansas had before it recently an appeal on error from a district court in the action of the Keene syndicate against the Wichita Gas, Electric Light & Power Company to recover rent due under a lease. On the 14th day of May, 1897, the Wichita Electric Railway & Light Company, a corporation under the laws of Kansas, with its place of business at the city of Wichita, entered into a contract or lease in writing with the Wichita Gas, Electric Light & Power Company, a corporation under the laws of Kansas, with its place of business at the city of Wichita. By the terms of the contract or lease the former leased to the latter for a period of 10 years, at an annual rental of $3000, payable semi-annually, certain machinery and appliances, in the city of Wichita, adapted to and used by the lessor for the purpose of generating electricity for light, heat and power. On the 20th day of March, 1900, the Keene Syndicate, a corporation, purchased of the lessor, the Wichita Electric Railway & Light Company, the property included in and covered by said lease, and also its interest in said lease, taking a written assignment thereof. The lessee, the Wichita Gas, Electric Light & Power Company, being in default of three years' rent in August, 1900, the Keene Syndicate, as assignee of the Wichita Electric Railway & Light Company, commenced its action in the district court of Sedgwick County to recover the rent, the amount claimed due it from the lessee. The syllabus of its decision against the lease by the Supreme Court is as follows: "A corporation, engaged in the business of generating and furnishing electricity for public and private use, leased to a rival corporation in the city, for a period of 10 years, machinery and appliances used in generating electricity, obligating itself by the provisions of said lease not to engage in the business of furnishing electric light and power to public or private consumers in the city during said period, and not to dispose of any of its property, machinery, or appliances retained by it for producing or generating in said city electric light and power. Held, in an action on said lease to recover rents from the lessee, that the lease is in contravention of public policy, and that no action to recover rents can be maintained thereon by the lessor or its assignee."

TELEPHONE LINE IN HIGHWAY.—The Supreme Court of Kansas in the suit of McCann vs. the Johnson County Telephone Company has decided that the construction and maintenance of a telephone line upon a rural highway is not an additional servitude for which compensation must be made to the owner of the land over which the highway is laid. The complainant was a farmer. In constructing a telephone line the Johnson County Telephone Company planted poles along the highway in front of his farm. The poles were placed near the hedge fence on the land dividing the farm from the highway, and were so located as to interfere with the trimming of the hedge, and also with the cutting of the grass and weeds on the roadside. He brought an action of injunction, alleging that the company had not obtained his consent to plant telephone poles on the highway opposite his farm, that his interest as the owner of the fee had not been conveyed, condemned, nor otherwise appropriated; and that no compensation had been paid to him for the proposed use. A temporary order, restraining the company from placing poles opposite the plaintiff's farm was issued, but on the final hearing it was dissolved, and a perpetual injunction was denied. The question presented in this appeal was, as at the first hearing of the proceeding, whether the telephone company might occupy the highway in front of McCann's farm without obtaining his consent or paying him compensation for the right. Was this a contemplated use when the road was established, or does it constitute an additional servitude? The court quoted with approval the decision in Cater vs. Northwestern Telephone Exchange Co.: "The methods of using public highways expanded with the growth of civilization until to-day our urban highways are developed to a variety of uses not known in former times, and never dreamed of by the owners of the soil when the public easement was acquired. Hence it has become settled law that the easement is not limited to the particular methods of use in vogue when the easement was acquired, but includes all new and improved methods, the utility and general convenience of which may afterward be discovered and developed in aid of the general purpose for which highways are designed; and it is not material that these new and improved methods of use were not contemplated by the owner of the land when the easement was acquired, and are more onerous to him than those then in use." The court held that the construction and maintenance of a telephone line on a country highway did not impose an additional servitude upon it, but was to be regarded more as a newly discovered method of using an old public easement.

OBITUARY.

E. B. CHANDLER, who was the first city electrician of Chicago, and afterwards western agent of the Gamewell Fire Alarm Telegraph Company, died at his home in Chicago, June 7. He was born in Hartford, N. Y., in 1838.

MR. W. A. VAIL.—William A. Vail, assistant general manager of the Northwestern Telephone Company, died of pneumonia at his home in Minneapolis on June 4. Deceased was well known in telephone circles throughout the country, especially in New York, where he was located for several years. Mr. Vail was 45 years of age.

PERSONAL.

MR. CHAS. R. GUERTLER, of the Engineering Company of America, is making an examination of the route for the proposed Roanoke and Mt. Airy electric railroad.

MR. DONALD MURRAY has reprinted in pamphlet form from the *Elektrotechnische Zeitschrift,* the elaborate article recently published on his automatic telegraphic system, written by Herr A. Kraatz. It is an exhaustive description.

DR. CHARLES BASKERVILLE, who attracted considerable attention a few months ago by "splitting" thorium into two elements, which were named carolinium and berzelium, has come to New York as head of the department of chemistry in the College of the City of New York.

MR. SAMUEL INSULL, president of the Chicago Edison Company, who has been taking a holiday with his family in England and on the Continent for some weeks past, has just returned, feeling much better for the change. Part of the stay in England was occupied with automobile tours.

MR. WALLACE C. JOHNSON, consulting engineer of the Niagara Falls Hydraulic Power & Mfg. Company, has been engaged by the Sientere Viva Mining Company, Bluefields, Nicaragua, to draw out plans and specifications, as well as to construct and equip extensive electrical power development and transmission systems in the locality of Bluefields.

MR. G. MARCONI has returned again on the Cunarder *Campania,* the trip being made with the object of starting up a regular newspaper service on the line by wireless. The newspaper proved very successful, plenty of news being received and printed on the trip. The *Cunard Daily Bulletin* is an excellent little sheet, and ought to prove a good journalistic property.

MR. ROBERT McF. DOBLE, of San Francisco, consulting and supervising engineer, making a specialty of hydro-electric power developments and long distance power transmission, announces that he has become identified with the Abner Doble Company, engineers and manufacturers of tangential water wheels with needle regulating nozzles. His offices will be at 417 Rialto Building, San Francisco.

MR. T. DURMAN, representing W. S. Laycock, Ltd., the well-known government and railway stores contractors of Sheffield, England, is on a visit to this country after about ten years' absence. He is very much pleased and surprised at the growth in that period. He is proceeding from New York to St. Louis, where he expects to devote some time to the Transportation Building. He will also visit some of the Western cities.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company, on June 3 gave an interesting talk before the Men's Club of the Methodist Church, Montclair, N. J., taking for his subject the business and social aspects of the telephone. Mr. Bethell's thorough knowledge of his subject and his masterly manner of presenting his facts insured deep and thoughtful attention from his audience.

MR. GEO. A. DAMON and Miss Henrietta B. Diller, daughter of Mr. and Mrs. Henry B. Diller, of Chicago, were married at Chicago, June 8. Mr. Damon is the managing engineer of the Arnold Electric Power Station Company, and has many friends and admirers among the electrical engineering profession in Chicago, where he is very prominent in technical circles. His recent paper on the earnings of electrical engineers attracted universal attention, and embodied a large amount of valuable data.

W. K. VANDERBILT, JR., is busily engaged studying electricity, says the *New York Times,* and getting informed on the technical points of railroad administration. The young millionaire is working in the department of Mr. W. J. Wilgus, fourth vice-president of the New York Central. He gets to his office every morning before 10 o'clock and leaves about 4. P. M. for his yacht, anchored at the foot of East Forty-second Street.

MR. W. C. GOTSHALL.—A few weeks ago Mr. W. C. Gotshall, president of the New York & Port Chester Railroad Company, while driving an automobile through one of the east side sections of New York City, with his wife, was attacked by a gang of roughs, who stoned the vehicle. Mrs. Gotshall was severely wounded on the head and her life was despaired of. We are glad to announce that she is now much better and will be able to be up and about within the next week. Meantime the hoodlums appear to have escaped punishment.

MR. S. S. FOLWELL, manager of the street railway department of G. D. Peters & Company, London, was in New York this week winding up a visit of some two months in this country. Mr. Folwell states that the business outlook on the other side of the Atlantic is good. G. D. Peters & Company have just secured the contracts from the Underground Electric Roads, of London, Ltd., for the car seats and blinds for the 420 new electric cars which will shortly be used in the District Underground Railway. This is the old original London Underground which is now being electrified. The seats are "Hale & Kilburn," similar to the seats used on the Manhattan Elevated Railway.

Trade Notes.

THE TWYFORD MOTOR CAR COMPANY, Brookville, Pa., is erecting a two-story building, 50x200 feet, and has ordered all the machinery for its equipment.

W. M. SHEEHAN & COMPANY, 136 Liberty Street, N. Y. City, have issued catalogue No. 25, a neat little pamphlet devoted to direct and alternating current fan motors of all styles of application. These are all illustrated, and sizes and prices are given.

DIXON'S GRAPHITE CUP GREASES are the subject of a neat little special pamphlet issued by the Joseph Dixon Crucible Company, of Jersey City, N. J., and devoted to a discussion of this interesting subject, as well as giving details about the varieties, etc.

"NOSCRU" PUSH BUTTONS.—The Sarco Company, 906 Sixth Avenue, New York, manufacturer and owner of several electrical appliances operated without screws, particularly the "Noscru" push button, reports that where dealers are running short of midget push buttons they are ordering the "Noscru" in preference to others having screw connections. Some of these devices have been recently described and illustrated in these columns.

THE NERNST LAMP.—A very useful and interesting, as well as attractive little pamphlet has just been issued by the Nernst Lamp Company, of Pittsburg, entitled, "The Value and Utility of the Nernst Lamp to the Central Station." It is not only a brisk discussion of the subject, in cogent terms, but embraces considerable data. Our central station readers ought to secure a copy.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces the fact that it is prepared to furnish D. & W. fuses and blocks, up to 800 amperes in both 250 and 500 volts. The company is also authority for the statement that the demand for D. & W. material is still increasing and says that the most fortunate thing about it is that a customer who tries D. & W.'s is sure to continue using them.

NATIONAL-ACME.—The National-Acme Manufacturing Company, of Cleveland, Ohio, announces the opening of a New York office at 220 Broadway, in charge of Mr. R. A. Scranton, manager, to attend to business in this part of the world in its Acme automatic multiple spindle screw machines, screw slotters, cap screws, set screws, etc. Local orders and inquiries will receive prompt attention from Mr. Scranton.

THE EMERSON ELECTRIC MFG. COMPANY, of St. Louis, reports that prompt shipments can be made of Emerson desk and ceiling fans for any regular voltage or frequency. This company, as usual, is carrying a well-assorted stock in New York City, as well as in St. Louis, and Eastern customers can depend upon receiving prompt service from New York City. Over twenty styles are regularly carried in stock.

ELECTROLYTE FOR STORAGE BATTERIES.—The Franklin H. Kalbfleisch Company, New York, the well-known manufacturing chemist, has just issued a little pamphlet giving some extracts from publications of various concerns, and the published works of authorities as to the importance of using pure chemicals in storage batteries. All of the authors are unanimous on this point. The Kalbfleisch Company guarantees its electrolyte to be made from pure Sicily brimstone sulphuric acid and distilled water.

THE CRESCENT COMPANY, of Chicago, has shown its faith in the time switch as the coming way for handling show window signs and hall lights by taking the exclusive Western agency for the Crescent time switch. To get this agency, it had to contract for an immense number of these machines. The hustling abilities of this company are a guarantee that they will be distributed. This device has met with great favor on account of its low price, simplicity and positive action. Bulletin 205 fully describes it.

EWING-MERKLE ELECTRIC COMPANY, of St. Louis, Mo., has issued an illuminated and indexed map of the World's Fair grounds and the pike, which is remarkable in its completeness and convenience. It is 8x12 inches in size and folds up into a neat envelope, so that it can be easily carried in the vest pocket. It shows the location of every building and every feature on the grounds, and the index enables one to find instantly the location sought. A copy will be given free to anyone who applies for it either personally or by mail.

MESSRS. JORDAN BROS., 58 Fulton Street, New York, have brought out an ingenious exhaust and ventilating device which is easily and readily installed. It consists of a separate window sash which is screwed on the inside of the window case. In the window pane is cut out a circular hole of the same diameter as the fan guard, and an electrically-driven fan is mounted on a bracket so that it can be placed in front of the aperture in the window and moved away from it when it is desired to close the opening, which is done by raising the regular window sash. The fan is then swung back against the wall. This device is recommended for offices, private residences, churches, clubs, yachts, restaurants, etc. It keeps the air pure and clean in winter without draft or lowering the temperature of the room, and in the summer doing an equally valuable service either as an exhaust or suction fan.

NILES-BEMENT-POND COMPANY.—The May bulletin of this company has some very interesting data in its twelve handsome quarto pages. The first page shows a new 10-foot mill for use on high power tool steel, and another fine tool shown, as well as described is the 3 by 36-inch turret lathe, Pratt-Whitney type. A striking tool also is that driven by electric motor, a 108-inch Bement lathe, which swings 109½ inches over the bed and 74 inches over the carriages. A controller handle is provided for each carriage, so that the speed of the lathe can be conveniently controlled by the operator without change of position. There are also shown a 90-inch driving wheel lathe, a No. 11 vertical milling machine, hydraulic angle and bar shear and splitting shear. A very interesting view is that of a horizontal boring, drilling and milling machine on a milling job on the base of a casting too large to go through the planer.

A STERLING INVITATION.—Mr. W. E. Doolittle, president of the Sterling Electric Company, of Lafayette, Ind., has issued the following hearty circular of invitation: "The Indiana State Telephone Convention has been called to meet in Lafayette, June 28 and 29. As this is the home of the Sterling Electric Company we shall use every effort to make this the largest state convention upon record. From assurances already given, we believe we can state that there will be from 200 to 250 representatives of operating companies present. The headquarters will be at the Hotel Lahr. We have provided as entertainment for all; street-car ride, vaudeville show at Tecumseh Trail (a summer garden), inspection of Purdue University, boat ride, banquet at the German National Park, and a general good time. We wish to extend our invitation in addition to the notice of the Association, requesting that you be present. We assure you that you will be accorded every privilege that we have ourselves and will be treated with all fairness. We shall at least endeavor to make the Convention a pleasant one and sincerely hope that you will make it a profitable one. Give the matter your early consideration and arrange to be represented. Would suggest that you make an early reservation, and would be pleased if you would notify us the number of people you will have present so that it will assist us in arranging for the entertainment."

THE ELECTRIC SUPPLY COMPANY, of Savannah, Ga., is now doing business at No. 38-40 Drayton Street, with a branch store at No. 309 Bull Street, devoted almost exclusively to the automobile business. This company is now recognized as a factor in the electrical supply business of the South. Its customers are found all throughout the States of Georgia, Florida, Alabama, South Carolina and Texas. Its prominent Southern location and its fine new stores and sales rooms with increased shipping facilities, enable it to handle its fast increasing business with much better satisfaction to customers. It has quite a line of first-class specialties, such as Circular Loom flexible conduit, Fostoria incandescent lamps, Crocker-Wheeler motors and dynamos, and all standard makes of electric ceiling and desk fans. It also carries a large stock of general supplies and is increasing its line constantly by putting in new specialties as fast as perfected. This company's construction department has secured contracts since June 1 amourting to nearly $50,000. This covers the wiring of government buildings at Fort Dade, Fort De Soto and Fort Barrancas, Fla., and Fort Screven, Ga.; the Jacksonville, Fla., Post Office annex, and the Savannah, Ga., City Hall Building. This company has just finished wiring the Central of Georgia Railway Co.'s office building at Atlanta, Ga., and installing chandeliers in the Germania Bank Building at Savannah, Ga., and is now wiring the County Court House at Washington, Ga., and installing the Sandersville, Ga., electric light plant. The company's new venture—its automobile department—is meeting with great success, the business done the first two months having exceeded its most sanguine expectations.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 7, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

761,465. ELECTRICAL APPLIANCE; Philip H. Fielding, New York, N. Y. App. filed Aug. 26, 1903. A receptacle adapted for stringing lamps outside, it having the shape of a yoke to be saddled over a guy-wire and having means for making weather-proof connection with conductors and with the lamps attached to it.

761,637. TROLLEY GUARD; Linwood B. Aikens, Rockledge, Fla. App. filed March 24, 1904. A roller is mounted eccentrically on each side of the trolley wheel; when the wire leaves the wheel and falls upon a roller, the latter is caused to rotate and lift the wire to a position where it will again fall into the groove of the wheel.

761,641 and 761,642. EXCITING FLUID FOR ELECTRICAL BATTERIES; George F. Atwood, Wakefield, Mass. App. filed Oct. 3, 1903. (See page 1163.)

761,675. ELECTRIC CUT OUT; William J. Hartwig, Detroit, Mich. App. filed Feb. 29, 1904. Details of an inclosed fuse.

761,682. CONTINUOUS CURRENT DYNAMO; Emile J. Javaux and Alfred L. Barbou, Paris, France. App. filed Jan. 28, 1903. Iron rods are moved to a greater or lesser distance into passages in the pole pieces to interpose more or less iron in the magnetic circuit.

761,694. ELECTRIC RAILWAY SYSTEM; Charles H. Murphy, Scranton, Pa. App. filed Sept. 1, 1903. Details of a switching device for energizing sections of a third rail as the train traverses it.

761,743. ELECTRIC SWITCH FOR HIGH POTENTIALS; Gilbert Wright, Pittsfield, Mass. App. filed Sept. 24, 1903. The contracting surfaces are formed with corresponding inclines which come together upon the closing of the circuit, but which are not in contact while the circuit is held closed; the circuit is broken upon the same inclined surfaces, which therefore receive the effect of the arc and shield the main contact surfaces therefrom.

761,744. SWITCH CONTACT; Gilbert Wright, Pittsfield, Mass. App. filed Oct. 14, 1903. A modification of the preceding patent.

761,745. SWITCH FOR ELECTRIC CIRCUITS; Gilbert Wright, Pittsfield, Mass. App. filed Nov. 30, 1903. A further modification of 761,743 involving an oil switch.

761,748. CIRCUIT BREAKER; John R. Anderson, Jr., Pittsfield, Mass. App. filed Sept. 12, 1903. A device for adjusting finely the position of the magnet core with respect to the armature upon which it acts.

761,760. INSULATOR; Cummings C. Chesney, Pittsfield, Mass. App. filed

Aug. 8, 1903. A number of petticoats telescoped into one another with their edges of such shape and size as to be equidistant at all points.

761,776. CIRCUIT BREAKER; William J. Lloyd, Pittsfield, Mass. App. filed Aug. 19, 1903. The retractile spring on the armature is so disposed that its force diminishes as the armature is moved by the attraction of the magnet.

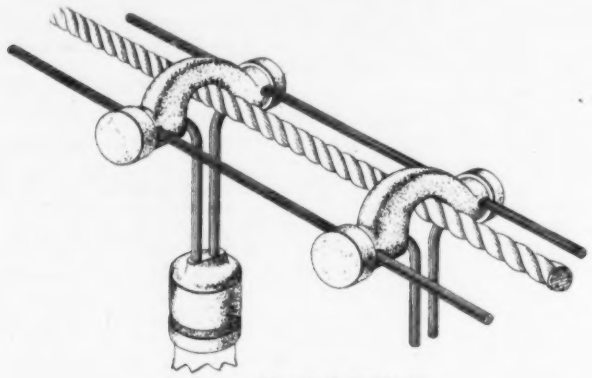
761,814. COMBINED INSULATOR AND FUSE BOX; Aaron Bearse, Syracuse, N. Y. App. filed Aug. 26, 1903. A knob insulator containing a chamber above the end of the pin for a fuse.

761,848. TROLLEY SIGNAL; Charles H. Morse, Cambridge, Mass. App. filed June 27, 1901. Details.

761,853. ELECTRIC RAILWAY SIGNAL; Robert J. Sheehy, New York, N. Y. App. filed Sept. 9, 1902. The current for operating signals in a block system is taken from the third rail power current by the car and transferred to another rail alongside the third rail; the latter is divided into sections and the signals are located in the cab of the car and are operated by arms at the roadside which are thrown into position automatically.

761,875. OVERHEAD ELECTRIC CARRIER; Charles M. Clark, South Orange, N. J. App. filed Nov. 24, 1902. The motor in a telpher system can be reversed and the bucket dumped at any predetermined point.

761,876. MEANS FOR REVERSING ELECTRIC MOTORS; Charles M. Clark, South Orange, N. J. App. filed Dec. 10, 1902. In a system similar to that previously described the breaking of the circuit through the motor throws a reversing switch, and upon a renewal of the current the parts are again put in position to reverse the motor.



761,465.—Electrical Appliance.

761,877. INSULATING BLOCK FOR ELECTRIC CONDUCTORS; Charles M. Clark, South Orange, N. J. App. filed July 7, 1903. Details of an insulating block used in the two systems preceding.

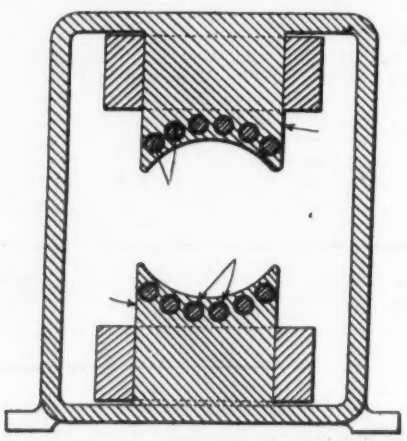
761,884. TELPHER; Henry M. Harding, New York, N. Y. App. filed Dec. 3, 1902. Means for regulating the lowering and hoisting of the bucket and means by which the circuit through the motor will be automatically broken and the telpher returned to its starting place.

761,893. SYSTEM OF ELECTRICAL DISTRIBUTION AND CONTROL; Lamar Lyndon, New York, N. Y. App. filed Dec. 15, 1903. In a system of distribution where current is generated from a car axle, means are provided for bringing the generator wholly to rest under conditions requiring such action.

761,917. TELEGRAPH TRANSMITTER; Willis J. Roussel, New Orleans, La. App. filed Feb. 11, 1903. The movement of a key in a key-board rotates a disk through one turn and brings metallic segments in the surface of the disk, corresponding to Morse characters, successively into contact with a finger trailing thereon.

761,920. ELECTRIC FURNACE; Charles Prosper Eugene Schneider, Le Creusot, France. App. filed Oct. 12, 1903. (See page 1163.)

761,928. MEANS FOR MOVABLY CONTACTING ELECTRICAL CONDUCTORS; Frederick G. Walker, Cleveland, Ohio. App. filed Aug. 12,



761,682.—Continuous Current Dynamo.

1903. Two trolley wheels placed at an angle with their rims together to form a single groove for the wire.

761,971. APPARATUS FOR GENERATING ELECTRICITY; Andrew C. Kloman, Pittsburg, Pa. App. filed Sept. 18, 1903. In a thermal generator means for simultaneously heating and cooling different parts thereof and for reversing the conditions so as to simultaneously cool the heated portion and heat the cool portion.

761,985. ROCKER RING FOR ELECTRICAL MACHINES; Edson R. Norris, Wilkinsburg, Pa. App. filed Sept. 16, 1903. A clamping device for a split ring consisting of a loop carried at one end of the ring and adapted to engage an inclined surface on the other and to be held in position by a set screw.

761,987. RAILWAY TRACK CURRENT CONTROLLER; Alfred Oesterreicher, Vienna, Austria-Hungary. App. filed May 28, 1903. A short length of rail held by a spring against the side of the track rail, to be moved laterally by the flange of the car wheel and thus close a signal circuit.

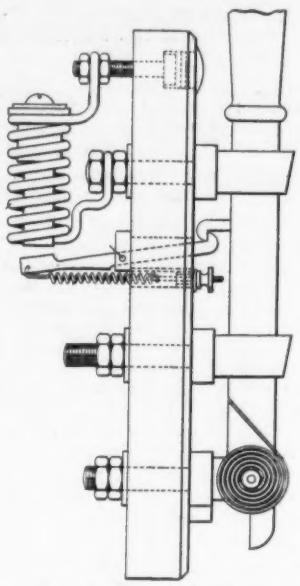
762,009. AUTOMATIC BLOCK SIGNALLING SYSTEM; Herbert B. Taylor, Newark, N. J. App. filed Oct. 14, 1903. Details.

762,030. INCANDESCENT LAMP; Samuel E. Doane, Cleveland, Ohio. App. filed Dec. 12, 1903. Certain kinds of metal have the same coefficient of expansion as glass and which could not heretofore be used for leading-in wires, on account of oxidizing and permitting leakage, are made available by plating them with an inoxidizable metal.

762,034. ELECTRIC SWITCH FOR MOTOR CARRIAGES; Henry Folger, West Somerville, Mass. App. filed Dec. 18, 1903. The handle of an ordinary three-point switch is made readily detachable for the purpose of disabling the switch.

762,074. BRUSH HOLDER; Emil S. Lueth, Baraboo, and Charles D. Knight, Milwaukee, Wis. App. filed March 21, 1904. An eccentric clamp for holding the torsion spring at any degree of tension.

762,105. ELECTRIC SEMAPHORE SIGNALING MECHANISM; Bruno O. Wagner, Amsterdam, N. Y. App. filed May 12, 1903. Details.



761,776.—Circuit Breaker.

762,111. ELECTRICALLY CONDUCTIVE COIL AND METHOD OF CONSTRUCTING SAME; Vincent G. Apple, Dayton, Ohio. App. filed Sept. 21, 1903. The layers between which the higher differences of potential exist are separated by thicker insulation than the other layers.

762,112. ELECTRICALLY CONDUCTIVE COIL AND METHOD OF CONSTRUCTING SAME; Vincent G. Apple, Dayton, Ohio. App. filed Sept. 21, 1903. Ribbon conductors are wound upon the core simultaneously with strips of paper which are so laid as to furnish the necessary insulation between adjacent turns.

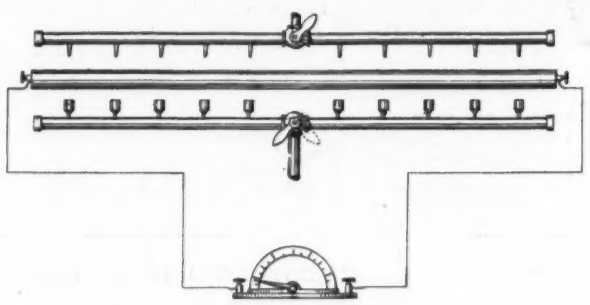
762,114. REGULATING DEVICE FOR ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 25, 1902. The apparatus consists of a reactance device in series with the translating devices, the magnetic pull of the reactance device being opposed by a weight so regulated that the choking effect of the coil will vary automatically to compensate for changes in the resistance of the circuit.

762,125. ELECTRICAL TEMPERATURE ALARM; Joseph P. Bolton, Fresno, Cal. App. filed June 16, 1902. Contacts are adjustable in the path of movement of the needle of a thermometer.

762,141. ELECTRIC MACHINE; Niels A. Christensen, Milwaukee, Wis. App. filed April 8, 1901. A dynamo or motor is provided with a back-gearing device which is made adjustable for the purpose of using the machine on the floor, ceiling or wall.

762,192. SIGN RECEPTACLE; Clarence D. Platt, Bridgeport, Conn. App. filed Jan. 11, 1904. Details.

762,204. CIRCUIT BREAKER; Frank L. Sessions, Columbus, Ohio. App. filed June 16, 1902. Flat faced carbon contacts overlap each other, one of them sliding onto and off the other, the stationary plate being so mounted



761,971.—Apparatus for Generating Electricity.

as to assume a position which will ensure contact throughout the entire abutting surface.

762,215. SEARCHLIGHT; William O. Webber, Boston, Mass. App. filed Jan. 6, 1904. A traversing and make and break device whereby the light is caused to traverse intermittently over any desired arc and automatically reversed at each end of the traverse.

762,227. ANODE AND PROCESS OF MAKING SAME; Henry Blackman, New York, N. Y. App. filed Dec. 8, 1896. (See page 1163.)

762,229. EXPLOSIVE CARTRIDGE; Giovanni Cornara, Mantova, Italy. App. filed Dec. 31, 1897. (See page 1163.)

762,249. SAFETY STOP DEVICE FOR STATIONARY STEAM ENGINES; Charles A. Ott, Lincoln, R. I. App. filed Oct. 31, 1903. An electro magnet when energized operates a trip to move a controlling valve.

762,257. SYSTEM OF DISTRIBUTION; William M. Scott, Philadelphia, Pa. App. filed Aug. 18, 1903. A circuit breaking mechanism.

12,228. STORAGE-BATTERY ELECTRODE; Johannes von der Poppenburg, Charlottenburg, Germany. App. filed Nov. 12, 1903. (See page 1163.)

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POSITION WANTED.—By man of experience in incandescent lamp manufacture; being employed as assistant superintendent of lamp factory he is perfectly familiar with the work of each department; is thoroughly experienced in making, treating and calculating sizes of filaments to suit the various lamps and is well posted in each of the other operations. Address No. 1442, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of lighting or railroad company, or would take charge of testing department of large concern; have had eight years' experience in the lighting and power field and am at present in charge of a department of one of the largest manufacturing concerns; good executive ability. Address No. 1525, care Electrical World and Engineer, New York.

POSITION WANTED.—By electrical engineer, technical graduate; experienced in designing, installing and operating electrical equipment for manufacturing plants; desires similar position with new plant or charge of operation of existing one; individual motor drives and design of equipment for special work; best of references. Address No. 1527, care Electrical World and Engineer, New York.

POSITION WANTED.—By a first-class engineer and electrician where a good hustler is wanted; for past three years was superintendent of 2000-kw alternating current plant which I installed; also wired buildings (all conduit work) for about 2000 lights; am a hustler for business; can handle men; 18 years' experience in this line; served my time with Westinghouse Company; age 39, married, of good appearance; hold chief engineer's license, New York City; best of personal references. Address No. 1518, care Electrical World and Engineer, New York.

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WANTED.—Three experienced incandescent lamp salesmen, by an old and well established company not in the Trust; applicants will please state age, experience and salary wanted. Address No. 1447, care Electrical World and Engineer, New York.

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WANTED.—A thoroughly experienced man as foreman of shop near Buffalo, manufacturing electrical machinery; must have thorough knowledge of shop tools and be able to take full charge; state experience and wages expected. Address No. 1528, care Electrical World and Engineer, New York.

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ALTERNATORS—60 CYCLES

	Lt.	
2	300	Westinghouse, 15-K.W.
1	500	Wood, 25-K.W.
1	600	West., 30-K.W.
1	900	West., 45-K.W., 2 phase.
2	1200	West., 60-K.W.
1	1500	Warren-Medberry, 75-K.W.
1	1500	Stan., inductor, 75-K.W., 2 ph.
1	1500	West., 75-K.W.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Wood, 75-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES

	Lt.	
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	900	Warren-Medberry, 45-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1500	Stanley, inductor type, 75-K.W.
1	2400	Gen. Elec., 120-K.W., type A 120.
2	2400	Gen. Elec., 120-K.W., type A. S.
2	3000	Stanley inductor type, 150-K.W.
1	8000	West., 400-K.W.

110 TO 125 VOLT GENERATORS (COMPOUND.)

DIRECT CURRENT.

	Lt.	
2	35	Hobart, Multipolar.
1	45	Lundell.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
2	50	Northern, Multipolar.
1	50	Westinghouse, Multipolar.
2	60	Hobart, Multipolar.
1	80	Fort Wayne, Multipolar.
1	80	Crocker-Wheeler.
1	80	Riker, Multipolar.
1	80	Perrett, Multipolar.
1	100	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Edison.
1	150	Eddy, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	160	Triumph, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	300	Phoenix, Multipolar.
1	300	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	300	Gen. Electric, Multipolar.
1	300	Western Elec., Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Edison, 25-K.W.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
1	540	Edison, 30-K.W.
1	540	C. & C., 30-K.W.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine, class A, upright.
2	700	Commercial, Multipolar.
1	700	Card, Multipolar.
1	700	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp., 50-K.W.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine.
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
1	2200	Western Electric, Multipolar, 125-K.W., 6 pole.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

220 TO 250 VOLTS COMPOUND GENERATORS.

	K.W.	
1	7½	Holtzer-Cabot.
1	9	New England, Multipolar.
2	10	T.-H.
1	12	Western Elec., Multipolar.
1	17½	Kester.
1	17½	Eddy.
1	20	Western Electric.
1	20	Keystone, Multipolar.
1	20	Eddy, Multipolar.
2	20	Western Elec., Multipolar.
2	30	C. & C.
1	40	C. & C., Multipolar.
1	40	Eddy, Multipolar.
1	40	Commercial, Multipolar, d. c. to 11x12 automatic Chandler-Taylor engine.
1	45	Edison.
1	45	Am. Engine Co., Multipolar.
1	45	Western Elec., Multipolar.
1	45	C. & C., Multipolar.
1	45	Gen. Elec., Multipolar.
1	50	C. & C.
1	50	Commercial, Multipolar.
1	50	Maine, Multipolar.
1	55	Fuller, Multipolar.
1	55	Eddy, Multipolar.
1	60	Northern, Multipolar.
1	75	Siemens & Halske, Churchward type, Multipolar, direct connected to 14x14 Ideal engine.
1	80	C. & C.
1	100	Commercial, Multipolar.
1	125	Eddy, Multipolar.
1	150	National, Multipolar.
1	200	Eddy, Multipolar.
1	200	Westinghouse, Multipolar.
1	250	Western Elec., 6 pole.
1	300	Western Elec., Multipolar

ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M., 250 v. direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour.
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour.

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNITS
Dynamo Engine

50-K.W. 220 V. American Ball.
42-K.W. 220 V. Westinghouse, Alfrey.
30-K.W. 220 V. Gen. Elec. Arm. Sims.
50-K.W. 110 V. Eddy, Ames.
37-K.W. 110 V. West., Erie Ball.
30-K.W. 110 V. Westinghouse, Ames.
8-K.W. 110 V. Crocker-Wheeler, Case.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

85-K.W. Gen. Electric, M. P.
75-K.W. Gen. Electric, M. P.
45-K.W. General Electric.
15-K.W. Eddy, M. P.
7½-H.P. Gen. Elec., Type C E.
5-H.P. Gen. Elec., Type C E.
3-H.P. Gen. Elec., Type C E.
1-H.P. C. & C.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

150-K.W. Westinghouse.
75-K.W. Westinghouse.
55-K.W. Gen. Elec., M. P.
45-K.W. Edison.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. Holtzer-Cabot.
7½-H.P. Edison.
5-H.P. Diehl.
2-H.P. Diehl.

500 VOLTS DIRECT CURRENT

100-K.W. General Electric, M. P.
75-K.W. Westinghouse, M. P.
5-H.P. Sprague.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

40-H.P. Type C Westinghouse.
30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.

2 Phase, 440 Volts, 60 Cycles

100-H.P. Westinghouse.
40-H.P. Westinghouse.
30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
5-H.P. Gen. Elec., 220 volts.
5-H.P. Gen. Elec., 110 V.
3-H.P. Westinghouse, 110 or 220 V.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Electric, 220 volts.

1 Phase, 60 Cycles

½-H.P. Wagner.
½-H.P. General Elec.

1 Phase, 125 Cycles

5-H. P. Wagner, 110 volts.
1-H.P. General Electric.
¼-H.P. Emerson.

Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

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We make a specialty of second-hand **Dynamos and Motors** and **Repairs** and sell Dynamos and Motors that are better than the usual run. In fact our machines are practically new (except the price), consequently we get the best trade, that pay their bills promptly and can use large quantities; the best and largest companies in all lines are numbered among our customers.

Send for our "Monthly Bargain Sheet" and note the complete stock we have and the low prices named, for we have also solved the problem of furnishing the **best** and still being reasonable in our prices.

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New and Second Hand Dynamos, Motors and Wattmeters

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Refill Commutators or make them new to order.
Repair Arc Lamps and any piece of machinery or apparatus.
Install Electric Light and Power Plants complete, or any individual machine.
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CORRESPONDENCE SOLICITED.

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FOR BARGAINS OF DISTINCTLY BETTER QUALITY

4—75 K.W. G. E. 125 Volt M. P. Generators.
2—120 K.W. 2340 Volt A. C. General Electric.
2—120 K.W. 2340 Volt A 60 General Electric.
2—120 K.W. 2340 Volt A 70 General Electric.
3—3 circuit, 125 Light, 9.6 ampere brush arc dynamos.
800 M 2 double T. H. open arc dynamos.
200 M 2 single T. H. open arc dynamos.

500 VOLT.

1—500 K.W. G. E. M. P. type.
1—225 K.W. G. E. M. P. type.
2—375 K.W. Westinghouse direct connected.
1—225 K.W. Westinghouse direct connected.

ENGINES.

2—750 H.P. Allies to Cross Compound.
2—500 H.P. Ball Cross Compound.
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350 Ceiling Fans, 110 Volt, various makes and finish, all in good order.

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Machinery of all kinds bought, sold and exchanged.

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FOR SALE: In Alabama.

2—A-6 Thomson-Houston Alternators, single phase, 1100 volt, 125 cycle, slotted type armature.
1—Extra armature for above.
1—Thomson-Houston M-12 arc dynamo.
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1—L. D.-12 armature.
1—14"x16" McEwen High Speed Automatic Engine.
1—Westinghouse alternator, 75-K.W., 60 cycle, 2200 volt, single phase.

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Armature Winding, Armature Coils. Commutators, Gears and Pinions.

Our Specialty **Railway Field Coils** of Every Type

The ELLIOTT BROS. ELECTRIC CO.
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FOR SALE

One 20-H.P. Wagner motor
One 10-H.P. Wagner motor
speed 1500, 125 cycles, 104 volts.
Transformers
1—7-K.W.
1—10-K.W.
1—20-K.W.
with secondary voltages for either 104 or 208.
2—100-amp. switches General Electric, No. 22818.
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All the above have been used less than one year and are in first-class condition.

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BARGAIN SALE

1—600-H.P. Tandem Compound Horizontal Engine and 400-K.W. Generator from factory of recognized high-class builders, generator direct connected to Engine. Neither Engine nor Generator are yet built. Will sell Engine or Generator separate and arrange to suit any other Engine or Generator to suit purchaser. Generator can be A. C. any phase or voltage or D. C. any voltage. Will sell for $1000 less than cost. Address No. 1509, care Electrical World and Engineer, New York.

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30-K.W. Eddy dynamo to Watertown engine, 110 volts.
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80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

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60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
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60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.

These motors are dust proof and series wound.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

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700-K.W. 60 cycle, three phase Westinghouse, three bearing.
300-K.W. 60 cycle General Electric, direct connected.
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75-K.W. 60 cycle Ft. Wayne Wood, single phase.

133 Cycle

300-.KW. Stanley, 2 phase.
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500-K.W. General Electric Railway Generator.
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200-K.W. Edison Bi-polars, 250 volts, compound-wound.
100-K.W. 6 pole Western Electric, 125 volts, direct connected to 16x16 Ideal, latest type.
100-K.W. 8 pole General Electric, 125 volts, direct connected to 15½x16 New York Safety engine.
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We list no Engines here, but will send list of Engines, Corliss and Automatic, simple or compound, of all types, upon request. Write what you want.

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Electric Light plant in a city of from 5000 to 25,000 population.

Combined lighting and street railway plant will be considered.

Address with full details, price, etc., No. 1491, care Electrical World and Engineer, New York.

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The Robert L. McOuat Electrical Supply business is in my hands for reorganization. It has been in successful operation for eight years in Indianapolis. There is but one competing house. The books are open for the most careful investigation. The business has averaged $100,000.00 per annum. It can be doubled. It is a splendid opening for substantial investment. It requires only about $16,000.00 to make the purchase. Properly secured notes will be accepted. Address

ALFRED F. POTTS,
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125 S. Meridian St., Indianapolis.

FOR SALE

Well-established electrical supply business in western metropolis. Annual sales $150,000. Address

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9 panels of blue Vermont marble, 90" high by 28" wide and 2" thick in two parts. Top panel 65" high, sub-base 25" high. Six of these panels are designed for 4 wire 3 phase Feeder panels, each one mounting 1 Elden Automatic Oil Circuit Breaker, 4 pole, 100 ampere, 4500 volt 4 single pole S. T. knife switches with marble barriers, 100 amperes, 4500 volts.

3 Wagner Ammeters; 80 ampere with current transformers.

1 Mershon Volt meter Compensator arranged to plug on either phase.

3 Goose Neck Ills lamp brackets.

1 panel containing 1-10 ampere Ammeter with current transformer.

2 primary plug switches for arc circuit 10 ampere 5000 volts.

1 panel containing 2 Elden Auto oil circuit breakers, 200 ampere 4500 volts, 3 pole.

2 hand operated 3 pole S. T. oil switches, 100 ampere 4500 volts Elden make.

1 total load panel mounting. 1 Elden Auto oil circuit breaker 100 ampere, 4 pole, 4500 volt. 1 4 pole knife switch, 150 ampere, 4500 volts with marble barriers. 3 Wagner Ammeters 150 ampere with current transformers. 3 Stanley Recording Primary Wattmeters, 200 ampere.

Also one Swing bracket mounting 2 Wagner Volt meters, 150 volt with potential transformer. One arranged to be used with compensators and one to read Buss bar voltage.

2 Station Ground Detectors.

The Board has mounted on back 1 set (4 wire) Buss Bars, and all interconnections to switches, instruments, etc.

All the instruments and switches are in perfect condition, good as new, same being in use only two and one-half years, and can be seen in daily operation at our Power House.

Reasons for selling on account of being too small, and our intention to put in new board of larger capacity. Address.

UNION LIGHT, HEAT & POWER COMPANY
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THE MUNICIPAL COUNCIL OF THE FOREIGN SETTLEMENTS AT SHANGHAI, CHINA, hereby invites tenders for a concession for constructing and operating about 23 miles of Electric Tramways on the "Trolley System" in the streets of Shanghai.

Further information may be obtained upon application to Messrs. Fearon, Daniel & Co., Agents for the Council, 96 Wall Street, New York City, or by addressing Mr. Charles Mayne, Municipal Engineer, Shanghai, China.

Sealed tenders indorsed "Tender for Tramway Concession" should be addressed to J. O. P. Bland, Secretary of the Municipal Council, Shanghai, China.

WANTED TO BUY

Electric Light Plant in town of over 15,000 inhabitants. We also have a purchaser for a combination gas and electric plant in town of over 10,000 inhabitants. Describe fully, stating equipment and prices.

CENTRAL STATION ENGINEERING CO.
Old Colony Bldg., Chicago

FOR SALE

1—150-K.W. cycle 1040 volt G. E. monocyclic alternator, A-1 condition, $1000, f.o.b.
1—12x12 Erie Ball Engine, fine condition, $300, f.o.b. Address

No. 1521,
care Electrical World and Engineer New York

FOR SALE. Motor Generator Sets. Direct Connected Apparatus

IMMEDIATE SHIPMENT
IN STOCK Jersey City and St. Louis Factories.

The following Motor-Generator Sets—Immediate Delivery—NEW

150 K. W. General Electric Motor-Generator Set
150-H.P. 25 cycle, A. C. Motor, direct connected to 150-K.W. D. C. 550 volt generator, 500 R.P.M.

150 K. W. General Electric Motor-Generator Set
150-H.P. A. C. 60 cycle Motor, direct connected to 150-K.W. D. C. generator, 550 volts.

100 K. W. General Electric Motor-Generator Set
100-H.P. Motor, A. C. 25 cycle Motor, direct connected to 100-K.W. D. C. 550 volt generator, 600 R.P.M.

100 K. W. General Electric Motor-Generator Set
100-H.P. 60 cycle Motor, direct connected to 100-K.W. D. C. generator, 550 volt, 600 R.P.M.

STANLEY S. K. C. SYSTEM.

Alternating Current Side:

2—Synchronous Motors, type 2-P, 2400 volt, 90 kw., 7200 alternations, 900 R.P.M.

Direct Current Side:

2—Western Electric Generators, with double winding and double commutator, one commutator on each side of armature. Type 4 P, 65 kw., 230 volt, 260 ampere, 900 R. P. M.

1—37½ Kw. General Electric, direct current 250 volt, compound wound generator, mounted on common subbase and supplied with insulated coupling and direct connected to one 50 H.P. 2 phase, 60 cycle 400 volt induction motor.

2—15 Kw. Westinghouse Multipolar, 550 volt, direct current generators, mounted on common base and direct connected to 2-20 H.P., 3 phase, 25 cycle, 330 volt, type C, Westinghouse induction motors.

1—18 K.w. American Ball, 125 volt, 860 R. P. M. multipolar, latest type generator, mounted on common base and direct connected to 1-25 H.P. American Ball, 500 volt multipolar motor.

2—Crocker-Wheeler, 7½ H.P., 110 volt to 20 volt.

ALTERNATING CURRENT INDUCTION MOTORS.

25 CYCLE—2 AND 3 PHASE.

1—200 H.P. Westinghouse, 400 volt, type C, 2 phase, 25 cycle, 480 R. P. M.

5—50 H.P. Westinghouse, 220 volt, type C, 2 phase, 25 cycle, 480 R. P. M.

2—50 H.P. Westinghouse 400 volt, type C, 3 phase, 25 cycle, 480 R. P.M.

5—50 H.P. Westinghouse, 200 volt, 3 phase, 25 cycle, 500 R. P. M.

1—40 H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, complete with two 25 k.w., 25 cycle oil transformers

3—30 H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, 750 R. P. M.

2—20 H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, 750 R. P. M.

2—10 H.P. Westinghouse, 220 volt, 2 phase, 25 cycle, 710 R. P. M.

3—10 H.P. Westinghouse, 200 volt, type C, 3 phase, 25 cycle.

1—7½ H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, 750 R. P. M.

2—7½ H.P. General Electric, 440 volt, type I. class 4-7½, 750 R. P. M., form K, 3 phase, 25 cycle.

2—5 H.P. Westinghouse, 220 volt, type C, 2 phase, 25 cycle, 750 R. P. M.

3—5 H.P. General Electric, 440 volt, type, I. class 4-5, 750 R. P. M., form K, 3 phase, 25 cycle.

1—5 H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, 750 R. P. M.

3—5 H.P. Westinghouse, 200 volt, type C, 3 phase, 25 cycle, 1,200 R. P. M.,

2—3 H.P. Westinghouse, 400 volt, type C, 3 phase, 25 cycle, 750 R. P. M

ROTARY CONVERTERS.

2—375 K.w. Westinghouse A. C. D. C. Rotary Converters, the alternating end being designed for 2 phase, 25 cycle, 2,200 volt current, and the direct current end for 550 volt direct current. These machines are of the 6 pole type, and operated at a speed of 500 R. P. M., and are complete with step-down transformers and switchboards.

2—300 Kw. Westinghouse A. C. D. C. Rotary Converters, designed to receive 2 phase, 60 cycle, A. C. current, and delivering 535 volt direct current. Each motor is complete with a direct-connected starting motor. They are also provided with four 200 kw. Westinghouse Transformers, oil-cooled type, one pair for each rotary. The transformers are of the 2 phase type, with 900 volt primary and 380 volt secondary. Complete with panel switchboard for use with the above transformers and rotaries.

1—300 Kw. 385 Volt Westinghouse, 500 R. P. M., 2 phase, 25 cycle, 6 pole, alternating end, with pulley 38 in. diam. x 42 in. face. Direct current end 300 Kw., 550 volt, compound wound. Pulley on this set makes it possible to drive same as a direct or alternating current generator. Three bearings.

2—250 Kw. Westinghouse A. C. D. C. Rotary Converters, designed to receive a 2 phase, 60 cycle alternating current, and delivering a 535 volt direct current. Speed 720 R. P. M., and each rotary is complete with a direct-connected starting motor.

The two rotaries are also complete with four 150 kw. Westinghouse transformers of the oil-cooled type, for use in two pairs; that is, one pair for each rotary. The transformers are of the 3 phase 2 phase type, with 9,500 volt primary and 380 volt secondary. Also a complete panel switchboard for use with the above transformers and rotaries.

2—75 Kw. General Electric Rotary Transformers, designed for 3 phase, 60 cycle, 350 volt alternating current, and delivering 550 volt direct current. Speed 1,200 R. P. M.

Each rotary is complete with three type H General Electric transformers, primary 1040-2080, secondary 350 volts. Also standard General Electric panel-board for each outfit.

DIRECT CONNECTED ALTERNATING CURRENT GENERATORS.

25 CYCLE, 2 AND 3 PHASE.

1—1,500 Kw., fly-wheel type, 3 phase, 25 cycle, 11,000 volt alternator, direct connected to Cross Compound heavy duty horizontal Corliss engine, with cylinders 32 and 64 x 54. Speed 94 R. P. M.

1—500 Kw. General Electric, 13,000 volt, 3 phase, 25 cycle, type A. T. B., direct connected to Rice & Sargent cross compound Corliss engine.

2—200 Kw. Westinghouse, 220 volt, 3 phase, 25 cycle, 214 R. P. M., direct connected to 2 separate 17½ x 21 simple, horizontal automatic Buckeye engines.

60 CYCLE, 2 AND 3 PHASE.

1—800 Kw. General Electric, type A. T. B., 72-800-100 R. P. M., 3 phase, 60 cycle, 2,300 volt, revolving field. Direct connected to 27 and 54 x 42 Vertical cross compound McIntosh & Seymour engine.

1—600 Kw. General Electric, 3 phase, 60 cycle, 605 volt, type A. T. B., 80-600-90 R. P. M., direct connected to 32 x 48 Allis simple, horizontal Corliss engine, 90 R. P. M.

1—325 Kw. Walker, 2,300 volt, 2 phase, 60 cycle, 120 R. P. M., engine type generator, direct connected to 1-17 and 29 x 30 horizontal tandem compound Erie City engine.

1—225 Kw. Walker, 2,300 volt, 2 phase, 60 cycle, 120 R. P. M., engine type generator, direct connected to 1-15 and 26 x 27 Erie City tandem compound, Corliss engine.

1—150 Kw. Westinghouse, 2,200 volt, 2 phase, 60 cycle, 257 R. P. M., engine type generator, direct connected to 1-12 and 24 x 14 Harrisburg horizontal, tandem compound engine.

1-100 Kw. Westinghouse, 220 or 440 volt, 2 phase, 60 cycle, 257 R. P. M., engine type generator, direct connected to 1-13 and 22 x 15 Ide compound engine.

3—125 Kw. Westinghouse, 60 cycle, 1,100 or 2,200 volt, 2 phase alternators for direct connection. Speed 250 R. P. M. We offer these with vertical Westinghouse compound engines, with cylinders 16 and 27 x 16 in. or other engines could be furnished if necessary.

1—125 Kw. Westinghouse, 1,100 volt, 2 phase, 60 cycle, 240 R. P. M., engine type generator, direct connected to 1-13 and 22 x 14 Erie Ball vertical, cross compound engine.

1—75 Kw. Westinghouse, 1,100 volt, 2 phase, 60 cycle, 300 R. P. M., engine type generator, direct connected to 1-14 x 14 horizontal, automatic, simple engine.

ALTERNATING CURRENT INDUCTION MOTORS.

60 CYCLE, 2 AND 3 PHASE.

1—150 H.P. General Electric, 440 volt, Type I. class 12, 150-600-440 form L, 3 phase, 60 cycle, induction motor, complete.

1—100 H.P. General Electric, 550 volt, 3 phase, 60 cycle, form L, induction motor, complete.

1—100 H.P. General Electric, 2,200 volt. Type I, class 6-100-500, form L, 3 phase, 60 cycle, induction motor, complete with modern high tension panel board, bus-bar connections and angle-iron frame.

1—50 H.P. General Electric, 220 volt, 2 phase, 60 cycle, induction motor, complete.

1—50 H.P. General Electric, 220 volt, type form L., 3 phase, 60 cycle, 720 R. P. M., induction motor, complete.

1—40 H.P. General Electric, 220 volt, Type I., form L., 3 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—40 H.P. Westinghouse, 400 volt, Type C., 2 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—30 H.P. General Electric, 110 volt, Type I., class 8-30, form L., 3 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—30 H. P. General Electric, 110 volt, Type C., 2 phase, 60 cycle, 850 R. P. M., induction motor, complete.

1—30 H.P. Westinghouse, 220 volt, Type C., 3 phase, 60 cycle, 850 R. P. M., induction motor, complete.

1—30 H.P. Westinghouse, 220 volt, type C, 2 phase, 60 cycle, 850 R. P. M., induction motor, complete.

1—30 H.P. Stanley, 120-240 volt, 2 phase, 133 cycle, 1333 R. P. M., induction motor, complete.

2—30 H.P. General Electric, 220 volt, Type I., 3 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—20 H.P. General Electric, 220 volt, 3 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—20 H.P. Westinghouse, 220 volt, Type C., 2 phase, 60 cycle, induction motor, complete.

1—20 H.P. General Electric, Type I., form L., 3 phase, 60 cycle, 900 R. P. M., induction motor, complete.

1—15 H.P. General Electric, 220 volt, Type I., form K., 1200 R. P. M., 3 phase, 60 cycle, induction motor, complete.

1—15 H.P. Westinghouse, 220 volt, type C, 2 phase, 60 cycle, 930 R. P. M., induction motor, complete.

1—15 H.P. General Electric, 220 volt, Type I., form L., 2 phase, 60 cycle, 1206 R. P. M., induction motor, complete.

3—10 H.P. General Electric, 220 volt, Type I., form L., 1200 R. P. M., 3 phase, 60 cycle, induction motor, complete.

1—10 H.P. General Electric, 220 volt, Type I., form L., 3 phase, 60 cycle, 1200 R. P. M., induction motor, complete.

1—10 H.P. Stanley, 250 volt, 2 phase, 60 cycle, induction motor, complete.

1—7½ H.P. Westinghouse, 220 volt, Type C., 2 phase, 60 cycle, 900 R. P. M., induction motor, rotates in either direction, for direct connection to elevator drum.

2—5 H.P. General Electric, 220 volt, Type I., 2 phase, 60 cycle, 1-200 R. P. M., induction motor, complete.

ALTERNATING CURRENT GENERATORS.

3 PHASE, 25 CYCLE, BELTED.

1—700 Kw. Bullock, 13,200 volt, 25 cycle, 3 phase, 375 R. P. M.

2—300 Kw. General Electric, 6,600 volt, 3 phase, 25 cycle, Type A. T. B., class 6-300-500 R. P. M., Form A.

2—250 Kw. General Electric, 5,500 volt, 3 phase, 25 cycle, Type A. T. B., class 24-250-125 R. P. M.

1—150 Kw. Westinghouse, 450 volt, 3 phase, 25 cycle, 500 R. P. M.

ALTERNATING CURRENT GENERATORS.

2 AND 3 PHASE, 60 CYCLE BELTED.

1—600 Kw. Westinghouse, 2,400 volt, 138 ampere, 2 phase, 60 cycle, 330 R. P. M., alternating current belted generator.

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2—330 Stanley, 1,200-2,400 volt, 2 phase, 60 cycle, 360 R. P. M., inductor motor type.

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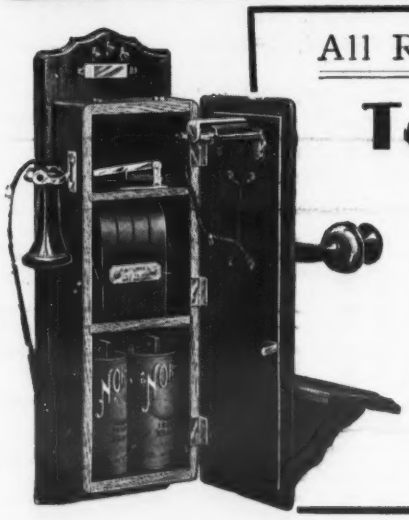

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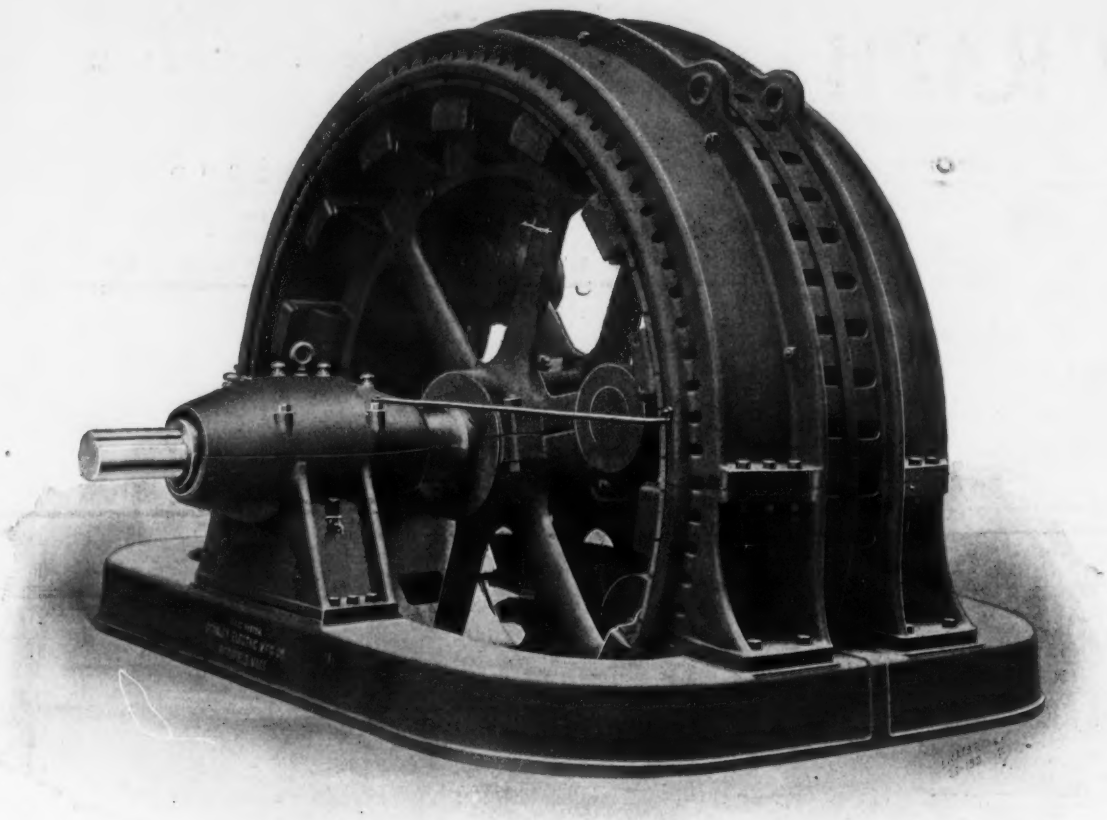

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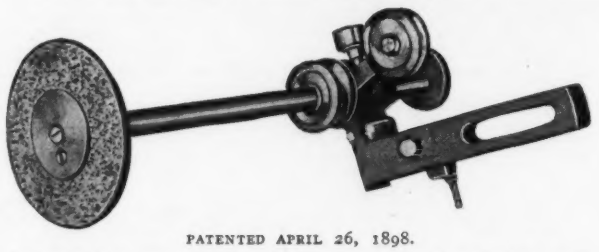

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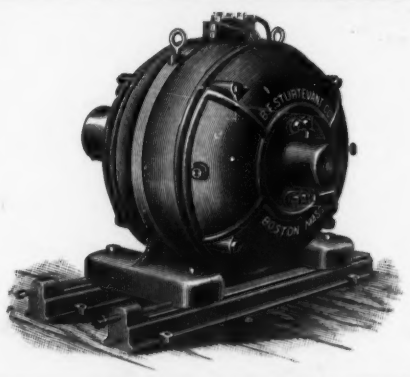

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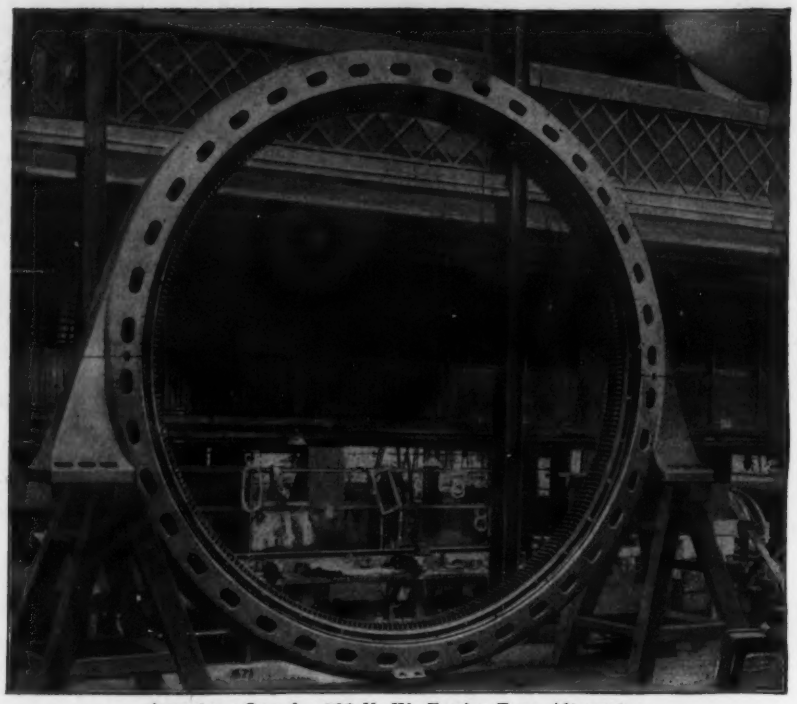

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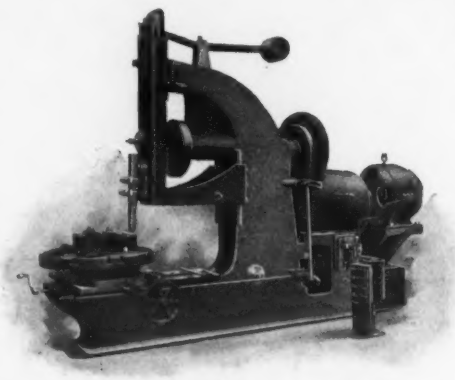

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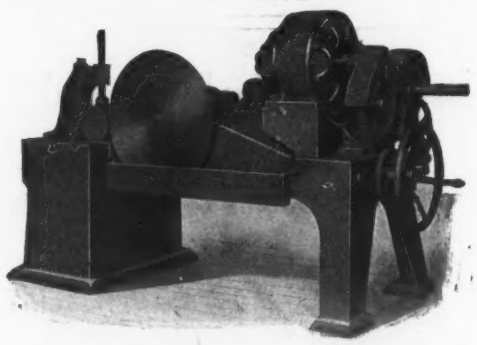

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